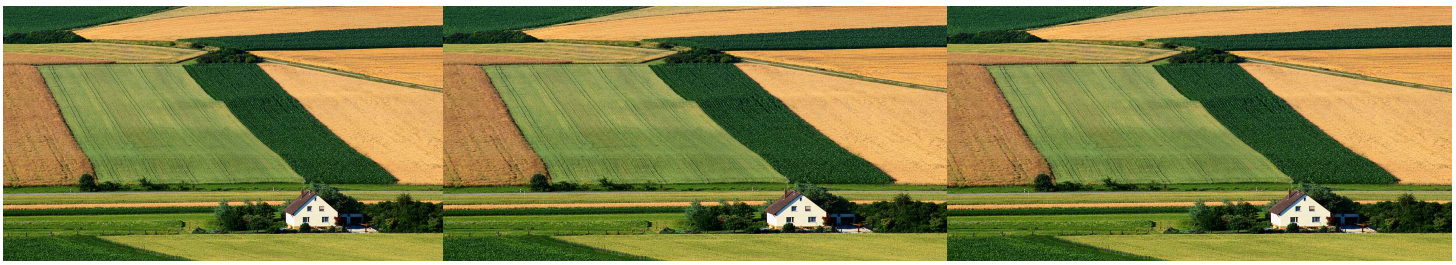
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

GUIDANCE MANUAL FOR THE LAND APPLICATION OF SEPTAGE WASTE



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ABBREVIATIONS

Agronomic Application Rate = AAR

Michigan Department of Environmental Quality = MDEQ

Feet or Foot = ft

Food Establishment Septage = FES

Gallons per acre per year = gal/ac/yr

Global Positioning System = GPS

Local Health Department = LHD

Michigan Compiled Laws = MCL

Michigan State University Extension = MSUE

Natural Resources Conservation Service = NRCS

Parts per million = ppm

Presidedress Soil Nitrate Test = PSNT

Pounds per acre = lbs/ac

Public Act = PA

Rate of Application = RA

United States Department of Agriculture = USDA

United States Environmental Protection Agency = USEPA

Wastewater Treatment Plant = WWTP

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CHAPTER 1

Introduction

Amendments to Part 117, Septage Waste Servicers, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 117), became law on October 12, 2004 in Michigan[4].

These amendments have resulted in significant changes in the requirements related to land application of septage waste in Michigan.

1.1 Importance of Land Application of Septage Waste

The proper and acceptable method for disposal of septage waste is still a topic of intense discussion. There is competition for agricultural land to be used for residential development, land application of septage waste, biosolids, and animal manure. The rapid development and expansion of residential homes, in what was considered rural areas that have on-site wastewater systems continues to generate septage waste that must be disposed. The high cost of constructing new wastewater treatment plants (WWTPs) or expanding existing WWTPs to accept and treat septage is a known challenge. Providing an alternative means of septage disposal that is economical and protects the environment and public health has become imperative. Land application of septage is an alternative method of septage disposal.

Land application of septage is beneficial in a number of ways. Septage provides important macro and micro nutrients for crop growth and can condition the soil for good crop growth. Growing feed crops such as forages can be a benefit to the animal industry. When land applied at agronomic rates, septage can reduce the need for some of the chemical fertilizers that would normally be used. However, improper septage management on land could result in crop damage and potential damage to the environment.

Proper management of soils, crops, and septage is important in maximizing the beneficial aspects of septage.

1.2 Objectives

This manual is intended to give guidance to licensed septage waste firms that land apply septage waste. It can also provide guidance for personnel of local health departments (LHDs) and state regulatory agencies that provide compliance oversight and enforcement of Part 117 septage law.

This document provides basic information that is expected to assist the licensee or land manager about how to manage the soils, crops, and septage at land sites. The goals of good management are:

- Prevent or reduce the risk to public health.
- Prevent or reduce the potential for nutrient and pathogen contamination of groundwater and other surface waters.
- Provide nutrients to grow crops for animal feed.
- Reduce the cost of disposal.

1.3 Land Application of Septage Waste and State and Federal Laws.

This document is mostly based on Michigan's Part 117, Septage Waste Servicers law[4]. Some aspects of the Federal 40 CFR Part 503 entitled "Standards for the Use of or Disposal of Sewage Sludge"[18] are discussed. Licensees that land apply septage waste are expected to meet both Part 117 and Part 503 requirements. Some references are made to Michigan Part 24, "Land Application of Biosolids[2]," and Federal 40 CFR Part 257, "Criteria for Classification of Solid Waste Disposal Facilities and Practices[17]." The guidance document is not intended to be a substitute for reading, understanding, and implementing Part 117, Part 503, and Part 24 and other applicable referenced

laws. There are some items in this manual that may not be explicitly stated in the laws referenced above but are considered good and generally accepted management practices for land application of septage waste. The reader is also encouraged to consult the “Generally Accepted Agricultural and Management Practices” (GAAMPs). This document is a product of the Michigan Right to Farm Act, 1981, PA 93.

Septage Waste: Where the word “septage” alone is used in this guidance manual, “septage waste” is implied. See Page 3 for septage waste definition.

Chapter 2

Definitions

2.1 From Section 11701, Definitions, Part 117[4]

Agricultural Land: Land on which a food crop, a feed crop, or a fiber crop is grown, including land used or suitable for use as a range or pasture, a sod farm, or a Christmas tree farm.

Certified Local Health Department: A city, county, or district department of health certified under section 11716.

Department: The department of environmental quality or its authorized agent.

Director: The director of the department of environmental quality or his or her designee.

Domestic Septage: Liquid or solid material removed from a septic tank, cesspool, portable toilet, type III marine sanitation device, or similar storage or treatment works that receives only domestic sewage. Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar facility that receives either commercial wastewater or industrial wastewater and does not include grease removed from a grease interceptor, grease trap, or other appurtenance used to retain grease or other fatty substances contained in restaurant waste.

Domestic Sewage: Waste and wastewater from humans or household operations.

Domestic Treatment Plant Septage: Biosolids generated during the treatment of domestic sewage in a treatment works and transported to a receiving facility or managed in accordance with a residuals management program approved by the department.

Food Establishment Septage: Material pumped from a grease interceptor, grease trap, or other appurtenance used to retain grease or other fatty substances contained in restaurant wastes and which is blended into a uniform mixture, consisting of not more than 1 part of that restaurant-derived material per 3 parts of domestic septage, prior to land application or disposed of at a receiving facility.

Governmental Unit: A county, township, municipality, or regional authority.

Incorporation: The mechanical mixing of surface-applied septage waste with the soil.

Injection: The pressurized placement of septage waste below the surface of soil.

Pathogen: A disease-causing agent. Pathogen includes, but is not limited to, certain bacteria, protozoa, viruses, and viable helminth ova.

Portable Toilet: A receptacle for human waste temporarily in a location for human use.

Septage Waste: The fluid mixture of untreated and partially treated sewage solids, liquids, and sludge of human or domestic origin that is removed from a wastewater system. Septage waste consists only of food establishment septage, domestic septage, domestic treatment plant septage, or sanitary sewer cleanout septage, or any combination of these.

Service or Servicing: Cleaning, removing, transporting, or disposing, by application to land or otherwise, of septage waste.

Site: A location or locations on a parcel or tract, as those terms are defined in section 102 of the land division act, 1967 PA 288, MCL 560.102, proposed or used for the disposal of septage waste on land.

Site Permit: A permit issued under section 11709 authorizing the application of septage waste to a site.

Storage Facility: A structure that receives septage waste for storage but not for treatment.

Tank: An enclosed container placed on a septage waste vehicle to carry or transport septage waste.

Type I Public Water Supply, Type IIa Public Water Supply, Type IIb Public Water Supply, and Type III Public Water Supply: Those terms, respectively, as described in R 325.10502 of the Michigan administrative code.

Type III Marine Sanitation Device: That term as defined in 33 CFR 159.3.

2.2 From United States Environmental Protection Agency (USEPA) Part 503[18]

Cover Crop: Small grain crop, such as oats, wheat, or barley, not grown for harvest.

Domestic Septage: As defined in the Part 503 Regulation, domestic septage is the liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives only domestic sewage.

Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar treatment works that receives either commercial wastewater or industrial wastewater and does not include grease removed from a grease trap at a restaurant.

Feed Crops: Crops produced primarily for consumption by animals.

Fiber Crops: Crops such as flax and cotton.

Food Crops: Crops consumed by humans. These include, but are not limited to, fruits, vegetables, and tobacco.

Groundwater: Water below the land surface in the saturated zone.

Pasture: Land on which animals feed directly on feed crops such as legumes, grasses, grain stubble, or stover.

Public Contact Site: Land with high potential for contact by the public. This includes, but is not limited to, public parks, ball fields, cemeteries, plant nurseries, turf farms, and golf courses.

Runoff: Rainwater, leachate, or other liquid that drains overland on any part of a land surface and runs off the land surface.

Wetlands: Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

2.3 Other Definitions[1] and Other Sources

Cover Crop: A crop planted primarily for the purpose of protecting and improving soil between periods of crop production.

Crop Rotation: A planned system in which crops are grown on the same area of land in a regular sequence. In this case, one type of crop grown during one cropping year is followed by another type of crop on the same area of land in the next cropping year. This is different from growing one type of crop continuously on the same area of land every cropping year.

Cropping Year: The period of time covering 365 days when septage application and management practices are implemented at a land site. The period is from October 1 of the previous year to September 30 of the current year.

An alternative cropping year of 365 days starting from January 1 to December 31 in a calendar year may be used under certain circumstances for certain licensees after due consultation and approval by the department.

Department Authorized Land Site: A land application site that has been authorized by the Michigan Department of Environmental Quality (MDEQ) to permit land application of domestic septage waste.

Erosion: Detachment and movement of soil or rock by water, wind, ice, or gravity.

Eutrophication: Nutrient enrichment of lakes, ponds, and other bodies of water that stimulates the growth of aquatic organisms, (e.g., algae and aquatic weeds) which leads to a deficiency of oxygen in the body of water.

Fallow Land: A land site that is not currently in cultivation with actively growing planned crops or vegetation.

Field: (see Site)

Isolation Distance: The distance from the nearest edge of MDEQ authorized septage application land site and a particular object (e.g., drinking water well, home, road, property line, etc.) being considered.

Land Application: A systematic and planned disposal of septage waste by surface or injection methods in a given field.

Land Manager: The person who grows and harvests the crop(s) at the department authorized land site.

Land (or field) Rotation: A planned system of site management where septage is applied on a specific authorized area of land during a cropping year. This is followed by growing a crop on that specific area during the next cropping year.

Land Site Management: The sum total of all tillage (mechanical manipulation) operations, cropping practices, application of septage waste, fertilizer, and lime and/or other treatments applied to the soil.

Lime (or Alkali) Stabilization: This is a septage treatment method involving the mixing of lime and septage.

Location (see Site)

Mineral Soil: Soil with soil organic matter less than 20 percent. Most soils used by land appliers fall into this category.

Mottling: Spots or blotches of different colors or shades of colors interspersed with the dominant color that occurs in the subsoil of a soil profile.

New Land Site: A land site that is not currently permitted for which land application is proposed.

Organic Soil: Soil with organic matter equal to or greater than 20 percent.

Planned Crop or Vegetation: This is a planned action adopted by the licensee to grow field, forage, or other crops or maintain vegetation as part of nutrient management strategy at the land site.

Ponding: The presence of septage waste liquid on soil surface after one hour of application if injection is the method used, and after 6 hours if surface application is the method used.

Screened or Ground Septage: Septage, as defined in the law, that has been screened through a screen of not greater than ½-inch mesh or slats separated by a gap of not greater than 3/8-inch

before land application. Septage may be processed through a sewage grinder designed to not pass solids larger than ½ -inch in diameter.

Septage Applicator Vehicle: The equipment that applies septage to the land site by surface application or injection.

Soil (or Land) Degradation: The decline in soil quality such that it is not capable of supporting good plant growth.

Soil Fertility: The status of a soil with respect to the amount and availability of nutrients to plants for plant growth.

Soil Horizon: A layer of soil, approximately parallel to the soil surface, differing in properties and characteristics from adjacent layers below or above.

Soil Map: A map showing the distribution of soil types or other soil mapping units in relation to prominent physical and cultural features of the earth's surface.

Soil Profile: A vertical section of the soil through all its horizons and extending into the parent material.

Soil Series: There is at least one dominant soil series at each land site. Soil series consists of soils that have similar horizons. The soil horizons are similar in color, texture, structure, consistence, and composition (mineral and organic).

Soil Structure: The arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are classified on the basis of size, shape, and degree of distinctness into classes, types, and grades respectively.

Soil Survey (County): This is a publication of the Natural Resources Conservation Service.

Soil Test: The laboratory analysis of a soil sample to determine soil pH and the amount and forms of plant-available nutrients using specific methods. Soil fertility testing is used to have a basis for knowing how much lime and nutrients to add to a soil to achieve maximum or optimum crop production. Soil test results are typically provided in a soil test report, along with nutrient and lime recommendations.

Soil Textural Class: Grouping into soil textural units based on the soil texture, e.g., sandy loam.

Soil Texture: The relative proportions of sand, silt, and clay. It also refers to the fineness or coarseness of the soil.

Surface Water: Means any of the following:

- The Great Lakes and their connecting waterways.
- Inland Lakes (greater than 5 acres).
- Rivers.
- Streams.
- Impoundments.
- Perennial open drains.
- Ponds and wetlands. Setbacks must be maintained from all perennial ponds and wetlands unless a site-specific variance is requested in accordance with Section 11720 of Part 117.

Vehicle Calibration: A systematic standardization of a vehicle to determine the quantity of material disposed. In land application of septage, vehicle calibration involves the standardization of the vehicle to give the quantity of septage applied per acre.

Water Table: The upper surface of groundwater or that level below which the soil is saturated with water.

Winter Months: Winter months are defined as December 21 to March 21.

Chapter 3

Soils and Crops

3.1 Soils

Understanding basic soil science is important because septage is added to soils and soils treat septage. The degree and efficiency of septage treatment by the soil will depend on the nature and properties of the soil and several other factors.

3.1.1 Soil Texture

Soil texture refers to the relative amounts of sand, silt, and clay present in a soil. Soil texture is probably the most important soil property because it determines the amount of surface area exposed by soil particles and largely governs the amount and size of soil pores. These properties will largely determine a soil's fertility (plant nutrient availability), water holding capacity, and water movement (infiltration, percolation, leaching), which in turn influences crop growth, erosion, and septage waste management.

3.1.2 Soil Textural Class

Soils with similar amounts of sand, silt, and clay are grouped into twelve textural classes, as shown in Figure 1.

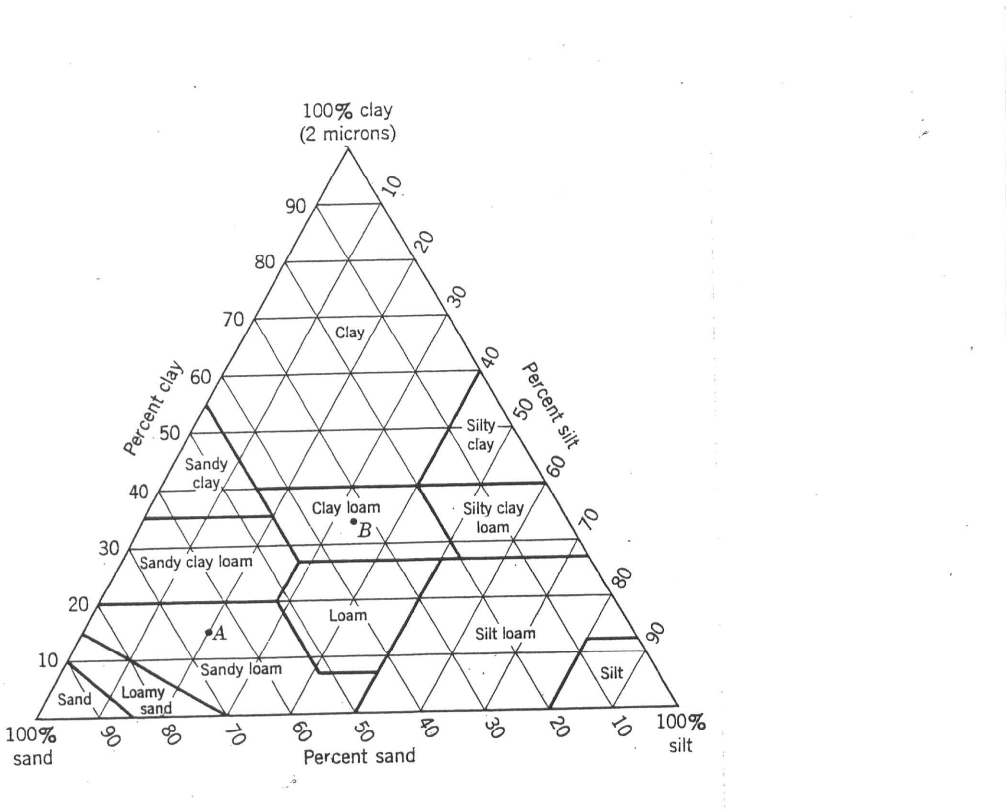


Figure 1. Soil Textural Class Diagram.

3.1.3 How to Know the Dominant Soil Textural Class at Your Land Site

Consult the soil survey of the county that gives information about the soil series of your land site. Soil series consists of soils that have similar horizons that are similar in color, texture, consistence, and composition. The soil survey gives information about how to manage the different soils found in a county and is produced by the Natural Resources Conservation Service[10].

Recommended Steps: The three major ways of determining the dominant soil textural class at septage application fields are the following.

- **Laboratory Analysis**: In this method, licensee takes soil samples from each major soil horizon of a soil profile. The soil samples are analyzed in the soil testing laboratory to determine the percent of sand, silt, and clay. Using Figure 1, the soil textural class can be determined for each horizon and then the dominant soil textural class of all the horizons can be determined. Where it may be impossible or impractical to determine the soil textural class for deeper soil horizons, the soil textural class of the top horizon (0 to 10 inches) may suffice as the dominant textural class for septage application purposes.

- **Soil Survey Map**: The soil textural class can be known by consulting the county soil survey map. Soil survey of a county is usually available in national, state, and local government offices or Michigan State University Extension (MSUE) Offices. This document contains information not only about the dominant soil type and soil textural class but also about how to best manage the soils at your septage application land site.

- **Feel Method**: Soil textural class can also be determined by the feel method. This is a practical determination of the soil in the field by working a little quantity of soil between the fingers with a little moisture. This method is usually described in introductory soil science books like Brady and Weil[1] and takes some practice and experience to make correct soil texture determination.

3.1. 4 Soil Groups and Septage Application

There is a broad range of soils in the soil textural classes that are suitable for septage disposal. The following groups of soil textural classes are provided as a guide in the choice and use of land sites for land application of septage.

Table 1. Soil Groups.

Soil Group	Soil Textural Class	Comments
1	Sandy clay loam, clay loam, silty clay loam, loam, sandy loam, silt loam, and silt	Soils in this group provide the best choice compared to soils in Groups 2 and 3. There are some soils in this category that will also provide some challenges, such as silt, silty clay loams, and clay loams.
2	Loamy sands and sands	Soils in this group are not able to hold or retain enough moisture for good crop growth especially during the summer months. The other challenge is keeping the nitrogen in the septage within the root zone. Due to their porosity, nitrogen in soil solution has a greater tendency to move quickly below the root zone and contaminate groundwater, especially if excessive amounts are applied.
3	Sandy clay, silty clay, and clay	Managing soils in this group will also provide some real challenges especially during the wet and dry periods of the year. During the dry periods, achieving proper incorporation after surface application will be a challenge due to the dense nature of the soil. It is difficult to achieve good incorporation. During the wet period or when septage is applied, the soils are very sticky and tires of trucks frequently get stuck and it is difficult to achieve good soil turnover. Water and nutrients are held very tight by the soil particles and do not readily release them for crop growth. These soils are generally not recommended for septage application due to the difficulty in tilling (incorporating and injecting) unless a special comprehensive soil management plan is submitted and approved before use.

3.2 Crops – Types and Choice

Understanding the differences between crops is important because crops assist in removing the nutrients from the soil where septage is land applied. Moreover, the rate of septage applied depends on a number of factors including the type and yield of the crop and the quantities of nutrients removed from the soil by harvested crops.

The following factors should be considered in selecting crops for the land site. These include among others:

- Crop use – What the harvested crop will be used for, e.g., feed, food crop, pasture crop, or cover crop.
- Crop adaptability – Whether the crop can survive and grow well in that environment.
- Crop management – Whether licensee or the land manger is willing and able to manage the crop from planting to harvest.
- Phosphorus management – Whether the soil phosphorus level in the field is high and the licensee intends to plant crops that will assist in phosphorus reduction.

A variety of crops can be planted at septage disposal sites. These crops include grain crops, forage crops, legume crops, and tree crops.

Grain crops include corn, barley, wheat, oat, rye, and sorghum.

Forage crops include alfalfa, birdsfoot trefoil, clover, orchardgrass, ryegrass, sorghum, and sudangrass, bromegrass, tall fescue, and timothy.

Legume crops include alfalfa, birdsfoot trefoil, clover, soybeans, and vetch.

Tree crops include cherry trees and Christmas trees.

These are common crops in Michigan. The list given above is not comprehensive. There are several other crops in each of the categories listed above that can be planted.

3.3 Soil Nutrients and Septage

The two major nutrients discussed in this manual are nitrogen and phosphorus. These nutrients are found in soil in different mineral and organic forms. Nitrogen and phosphorus are also present in septage waste. When septage is applied to land, these two nutrients should be managed to ensure that adequate quantities are available for optimal crop growth but that excess amounts are not added which can negatively impact water quality.

The fact that only two nutrients are dealt with in this manual does not mean the crop needs only nitrogen and phosphorus. It is important to keep adequate levels of the other 14-15 essential plant nutrients as well. Furthermore, the soil pH should be maintained at about 6.5 where the availability of all essential plant nutrients is the best. If any nutrient is not available in adequate amounts, crop growth will be limited, thereby limiting the uptake and harvest of other plant nutrients you are trying to manage.

3.3.1 Why Nitrogen?

Nitrogen is one of the essential plant elements and is important in plant development. Nitrogen is part of many essential plant components, especially amino acids which are the building blocks of proteins.

Nitrogen deficiency results in poor plant growth. Poor plant growth results in less nutrients being taken up by plants, which in turn may reduce the amount of septage that can be applied to the land site.

On the other hand, nitrogen in excess of plant requirements can lead to potential leaching of nitrate-nitrogen below the root zone to contaminate groundwater. Nitrogen is taken up in soil solution mainly in the form of nitrate and ammonium ions.

The uniform application of septage waste at an agronomic rate helps to reduce the introduction of excessive nitrogen into groundwater. Typically, nitrogen added to soils will be converted to nitrate-nitrogen by bacteria. High concentrations of nitrates leached to groundwater that is then used for drinking can cause health problems, especially for infants[1, 7].

3.3.2 Nitrogen Level in Soil and Nitrogen Soil Test

Although the Presidedress Soil Nitrate Test (PSNT) is a good indicator of the level of nitrogen that is available to crops, most soil testing laboratories do not test nitrate as part of a routine or basic soil test. This is mostly due to the fact that nitrate concentrations in soils are very dynamic and can change very quickly, making this test potentially unreliable for determining how much nitrogen may be available to crops.

Common sources of nitrogen at land application sites include:

- Domestic septage
- Biosolids* from wastewater treatment plants (WWTP)
- Chemical fertilizers
- Legumes
- Manure
- Other plant residues

*Biosolids should not be applied to an MDEQ authorized land site where septage waste is land applied[2].

Note: If you decide to request the soil laboratory to run a PSNT test, make sure you follow the directions as to how and when to sample the soil and how to handle the soil sample prior to submission to the laboratory for analysis.

3.3.3 Why Phosphorus?

Phosphorus is the other essential plant element discussed in this manual. Phosphorus is a key component of adenosine triphosphate (ATP), which is considered the energy source for many plant processes. It is also an essential component of deoxyribonucleic acid (DNA), a key part in genetics (hereditary) and ribonucleic acid (RNA), an important player in protein synthesis.

Phosphorus deficiency results in stunted plant growth and poor seed development. Over application of phosphorus can lead to accumulation of total and available phosphorus in the soil. Excess phosphorus in soil can potentially increase its solubility and mobility leading to its migration or movement to lakes, streams, rivers and other bodies of surface water. Phosphorus in surface waters can contribute to eutrophication (accelerating growth of algae and aquatic weeds).

3.3.4 Phosphorus Level in Soil and Soil Phosphorus Test

Common sources of phosphorus at land application sites include:

- Domestic septage waste
- Biosolids from WWTP
- Chemical fertilizers
- Manure
- Plant residues

The maximum allowable concentration of phosphorus in soil is 300 lb/ac (or 150 ppm) using the Bray P1 method, or 340 lb/ac (or 170 ppm) using Mehlich method[2].

Septage shall not be allowed to be land applied when the phosphorus level in soil at the land site has exceeded the maximum allowable concentration.

Conversion: Phosphorus in soil test reports is usually reported in pounds per acre (lb/ac) or parts per million (ppm)

It is possible to convert from one unit to the other as shown below.

Parts per million (ppm) to Pounds per acre (lb/ac)
ppm x 2 = lb/ac
Example: 98 ppm Phosphorus = 98 x 2 = 196 lb/ac

3.3.5 Phosphorus Loss

In general, phosphorus can be lost[1] from the soil, which includes soils at land sites from one or a combination of the following:

- In dissolved surface runoff water (0.01 to 2.68 lb/ac)
- In eroded soil particles (mineral and organic) (0.09 to 8.93 lb/ac)
- Crop uptake (4.47 to 44.65 lb/ac)
- Other chemical processes

In another source, crop uptake has been reported to be 18 to 53 lb/ac/year depending on crop type and yield[12].

Other Conversions:	lb/ac x 1.12 = kg/ha	ppm (wet) = mg/L
	kg/ac x 0.893 = lb/ac	
	lb P_2O_5 = lb P x 2.29	lb K_2O = lb K x 1.20
Explanations:	kg/ha (kilograms per hectare)	mg/L (milligrams per liter)
	P_2O_5 (phosphorus pentoxide)	K_2O (potassium oxide)
	P (phosphorus)	K (potassium)

3.3.6 Septage Waste Characteristics

According to Part 117, domestic septage is defined as "*Liquid or solid material removed from a septic tank, cesspool, portable toilet, type III marine sanitation device, or similar storage or treatment works that receives only domestic sewage. Domestic septage does not include liquid or solid material removed from a septic tank, cesspool, or similar facility that receives either commercial wastewater or industrial wastewater and does not include grease removed from a grease interceptor, grease trap, or other appurtenance used to retain grease or other fatty substances contained in restaurant waste.*"

The general septage characteristics as reported by United States Environmental Protection Agency[15] are shown in Table 2. This table is presented as a guide only.

Table 2. Septage Waste Characteristics

Wastewater Parameter	Septage mg/L	Sewage mg/L	Relative Strength Ratio (Septage : Sewage)
Compatibles:			
5 – day BOD	6,500	220	30 : 1
Chemical Oxygen Demand	32,000	500	65 : 1
Total Suspended Solids	13,000	220	60 : 1
Total Kjeldahl Nitrogen	600	40	15 : 1
Ammonia Nitrogen	100	25	4 : 1
Total Phosphorus	210	8	25 : 1
Oil and Grease	5,500	100	55 : 1
Toxics:			
Arsenic	0.140	0.003	50 : 1
Cadmium	0.100	0.003	33 : 1
Chromium	0.500	0.050	10 : 1
Copper	4.800	0.061	95 : 1
Cyanide	0.470	0.041	10 : 1
Lead	1.200	0.049	25 : 1
Mercury	0.005	<0.0002	>25 : 1
Nickel	0.500	0.021	25 : 1
Silver	0.100	0.005	20 : 1
Zinc	10.000	0.175	55 : 1

Domestic septage contains nutrients, heavy metals, and pathogens. The characteristics of the septage that haulers pump in Michigan may vary from location to location and from load to load. The emphasis in this manual is on nitrogen, phosphorus, and to some extent, pathogens.

All haulers that land apply are not required to sample every load of septage they pump or sample the septage in the storage tank for laboratory analysis in order to calculate the agronomic application rate. The option to sample septage for analysis is available to haulers who want to apply at rates that exceed the basic application rate stated in Option A (Appendix F). It is important to mix a load of septage in a storage tank before sampling or land applying.

3.3.7 Nutrient Removal by Crops

Crops remove nutrients such as nitrogen and phosphorus from the soil for their growth and development. The extent of nutrient removal depends on a number of factors such as:

- Amount of plant-available nutrient in the soil
- Stage of growth and maturity of crop
- Environmental conditions like moisture, temperature, soil pH, etc.
- Type, variety, and yield of crop

For additional information about nutrient removal, consult reference 20.

3.3.8 Soil Fertility Test (Soil Test)

A soil sample shall be taken from each field in an MDEQ authorized land site. A basic soil analysis shall be performed for pH, lime requirement, extractable phosphorus, potassium, calcium, and magnesium. The extractable phosphorus shall be determined using Bray P1 (Bray and Kurtz P1) or Mehlich3 testing methodology. A soil test report showing the parameters stated above shall be performed within one year before the date of application for a site permit. Thereafter, an annual soil test from each field shall be performed and a copy of the report shall be submitted to MDEQ. Where there is significant soil

variability within a field, more than one composite soil sample may be taken from the field and analyzed. The soil sample collected for the fertility test should be representative of the entire field where septage has been applied or will be applied.

Time of Sampling
Soil sample may be taken at any time in the cropping year provided the soil is not frozen or too wet.

Fall Sampling: Although soil samples can be taken at any time during the year, it is highly recommended that soil samples be taken in the fall of each year. Soil samples taken in the fall tend to give the licensee or land manager enough time to plan for spring and summer cropping the following year. Furthermore, it allows the licensee to submit the annual soil sample reports with the cropping plan and license maintenance fee due in March of the following year.

Number of soil samples: At least one composite sample shall be taken from each field. A composite sample is made up of 15-20 core samples depending on the size of the field. It could be less if the field is less than 5 acres. However, the more core samples you take to make a composite sample, the better it tends to represent the field.

Note: A summary description of how to take a soil sample for soil fertility test is given in Appendix A. You may also consult other references given in Appendix A about soil sampling for additional information.

Information to be submitted to Soil Laboratory with Soil Sample: A soil test report is not any better than how the sample was taken, handled, and the information submitted along with the soil sample. The following information shall be submitted along with the soil sample to the soil test laboratory.

- Land Site ID number (numerical) and Field number (alphabetical) where sample was taken
- Type of crop
- Expected yield of crop
- Previous crop
- Tillage depth (inches)
- Number of acres represented by the soil sample
- Whether or not manure* has been applied or will be applied in the same or subsequent cropping year

  * It is not recommended that manure be applied to an authorized land site where septage is land applied in the same cropping year. However, where manure is applied to such a land site, or will be applied, a comprehensive nutrient management plan is to be developed and submitted to MDEQ that accounts for the nutrient contribution from manure.

Soil Sampling by MDEQ
The MDEQ may take soil sample(s) from any field in an MDEQ authorized land site and send it in to any approved soil testing laboratory for analysis. The soil test report shall be evaluated along with the soil test report submitted to the MDEQ by the licensee.

CHAPTER 4

Land Site Characteristics, Identification, and Evaluation

4.1 Land Site Selection

The licensee is responsible for selecting the land site that will be used for septage waste disposal. The MDEQ is responsible for having the selected land site inspected and authorized for septage disposal if the site is found to be suitable.

Prior to submitting the land application form with applicable fee in order to secure a land site for septage disposal, a licensee should conduct a preliminary site evaluation on his/her own, taking into consideration factors such as:

- Type of soils
- Type of crops to be planted
- Soil test for phosphorus
- Slope of the land
- Depth to water table
- Isolation distances from disposal area
- Previous land use
- Remoteness of the site
- Accessibility to the site
- Distance from major septage business clients
- Personal preferences
- Predominant wind direction
- Other factors

4.2 Land Site Characteristics

4.2.1 Slope

The slope of the land site is important. The purpose is to ensure that septage applied on the land remains at the application site and is not carried away to adjoining properties or other bodies of water due to storm water run off or melting snow. As shown in Table 3, the maximum slope is 6 percent when surface applying septage. When using subsurface injection for applying septage, the land's slope shall not exceed 12 percent

Table 3. Slope Consideration.

Slope (%)	Surface Application	Injection
0 - 6	Permitted	Permitted
6.1 - 12	Not Permitted	Permitted
More than 12	Not Permitted	Not permitted

4.2.2 Water Table

Water table is the upper surface of groundwater or that level below which the soil is saturated with water. A seasonal high water table indicates the upper surface of groundwater at certain seasons of the year. Seasonal high water table can be assessed by observing the colors and patterns of coloration due to chemical processes in the soil (known as mottling), which can be seen in the soil profile. A soil profile is the vertical section of the soil from the top to about 4 to 5 feet below the surface. Mottling of soils is often used by soil scientists to determine the seasonal high water table, so this characteristic can also be used to evaluate the water table status at land application sites. However, for fields where drainage tiles are installed, the physical presence of water in a test pit, test hole, or monitoring well is the recommended method for assessing the depth to the water table, rather than using mottling.

4.2.3 Depth to Water Table

The depth to the water table **from where septage is applied** on the land site **shall not be less than 30 inches** at the time of application.

If surface application of septage is the method used, the depth to the water table should be measured from the lowest depth of septage after incorporation. If injection is used, the depth to the water table should be measured from the lowest depth of the septage after injection.

4.2.4 Tools for Water Table Measurement

A groundwater monitoring well or piezometer is one kind of equipment or tool that can assist in determining the water table. There are different kinds of monitoring wells or piezometers that are available on the market. Proper selection and installation are important factors in obtaining reliable data about the status of the water table at the land site. For those land application sites that may have a water table problem, it is recommended that the licensee or potential licensee consult the internet and other sources to determine the tool that would best meet the need. Moreover, the use of a monitoring well is more effective for coarse-textured soils than for fine-textured soils.

Depth to water table can also be assessed by observing the pattern and degree of soil mottling. This is usually described as the seasonal high water table as discussed in section 4.2.2.

4.2.5 Time of Water Table Measurement

It is best to measure the depth to water table at the time of the year when the water table will be at its highest. This means that measuring the water table in spring is preferred to measuring it in summer.

4.2.6 Isolation Distances

The following isolation distances shall be observed where septage is land applied. The isolation distance shall be equal to or exceed what is listed below in Table 4. Definitions of types of water wells can be found in the Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the administrative rules[3].

Table 4. Isolation Distances.

Features	Method of Application	
	Surface	**Injection**
Type I public water supply wells	2,000 feet	2,000 feet
Type IIa public water supply wells	2,000 feet	2,000 feet
Type IIb public water supply wells	800 feet	800 feet
Type III public water supply wells	800 feet	150 feet
Private drinking water wells	800 feet	150 feet
Other water wells	800 feet	150 feet
Homes or commercial buildings	800 feet	150 feet
Surface water	500 feet	150 feet
Roads or property lines	200 feet	150 feet

4.3 Land Site Identification and Description – New Land Site Requirements

An application for a new land site must be supported by detailed information as described in this section.

4.3.1 New Land Site Definition

Definition

See Chapter 2 page 4 for definition of new land site.

4.3.2 Application Process Items to be Submitted

When the licensee has selected the site, the licensee shall provide information that describes and identifies the land site as part of the application process for inspection and approval.

The following information shall be provided when applying for a new land disposal site or when your license expires and is renewed every 5 years:

4.3.2.1 Map

A map identifying site from county land atlas and plat book.

4.3.2.2 Latitude and Longitude

Latitude: Measurement in degrees north or south from the equator.

Longitude: Measurement in degrees east or west of the earth's surface, as an arc of the equator. They are both used to locate a specific point on the globe including land application sites.

4.3.2.3 Name and Address of Land Owner

4.3.2.4 Name and Address of Land Manager

4.3.2.5 Soil Fertility Test

(See Section 3.3.8 of this guidance document for details).

4.3.2.6 Vicinity Map

A map that identifies the location of the site location with respect to existing public and/or private roads. This may also be an aerial map. It could be a copy from a plat book with the site clearly identified.

4.3.2.7 Aerial Map

A map of the land site that is taken from the air. A vicinity map may also be an aerial map.

4.3.2.8 Topographic Map

A map that shows the relief (high and low points) of the soil surface at the land site, including slopes.

4.3.2.9 Soil Map

It is a map showing the distribution of soil types or other mapping units. Provide a copy of available soil maps and the description of the soil, soil profile, and the depth to the groundwater table for the land site intended for use as outlined in the United States Department of Agriculture, Natural Resource Conservation Service, Soil Survey issued for that particular county.

<u>Other Soils Information</u>

Where soil maps are not available, at least one soil test pit or auger boring, sunk at the center of an area that represents about 5 acres, shall be used to describe the soil characteristics and identify the soil textural class. The soil description should be prepared by a competent person that has knowledge about soils.

4.3.2.10 Land Site Plan
A plan drawn to scale (not less than 1 inch: 200 feet) showing the location of the septage application area in relation to:

- Homes or commercial buildings (800 ft)
- Private drinking water wells and other wells (800 ft)
- Surface water (500 ft)
- Property lines (200 ft)
- Roads (200 ft)

See Appendix B for a simple land site plan.

Also indicate the location of the following:

- Drainage field tiles, if any
- Storage tanks or proposed screening tanks for septage waste
- Easements or right-of-way
- Surrounding land use
- Soil test pits and/or auger borings
- Boundaries of each field (See Section 4.5.3 of this manual)
- Access roads
- Other areas within the land site that are available for septage application (See Sec. 4.3.2.11)
- Arrow pointing to the "north" direction

4.3.2.11 Land Site Area
Indicate the size of each field and the total number of acres for all fields at the land site that will be used for septage disposal. It is important that the entire area available for septage application be evaluated for authorization the first time evaluation is conducted. This is due to the fact that a new site evaluation with applicable fees may be needed if the licensee extends the septage area in subsequent years beyond the previously evaluated area. The extended part that was not previously evaluated may be considered a new-use evaluation.

4.3.2.12 Historical Site Use
Historical use includes, but is not limited to, manure application, biosolids application, crop rotation, and minimum or zero tillage systems. It is important to know from the land owner what kind of historical land use the land site has been subjected to in the past. Knowledge of historical site use can assist in planning and implementing good management for optimum crop growth. Optimum crop growth is vital for efficiently "mining" the nutrients applied from septage.

The following checklist may be used as a guide:

(Check all that apply)

- ☐ Site is currently or was recently (2 years or less) under forest
- ☐ Farm with manure application
- ☐ Farm with biosolids application
- ☐ Farm with regular crop rotation
- ☐ Farm with zero tillage
- ☐ Other _____

4.4 Application, Site Evaluation, Approval, and Authorization Process

The overall process leading to the permitting of a land site places distinct responsibilities on the licensee, authorized LHD, and MDEQ. This process is more fully discussed in this section.

4.4.1 Application - Licensee Responsibilities[4]

Step 1: Fill the applicable section(s) of the form EQP-5837 (Application for Site Permit to Land Apply Septage Waste).

Step 2: Attach all the required documents listed under 4.3.2.1 to 4.3.2.12. This is the application packet with documents.

Step 3: If payment is required, attach applicable fees by money order or check.

Step 4: Send the application packet to the MDEQ address given below:

Department of Environmental Quality
Cashier's Office-WB-SEP1
P. O. Box 30657
Lansing. MI 48909-8157

Step 5: The MDEQ Septage Program staff will review the application for completeness.

Step 6: If the application is determined to be complete, a copy of the application packet will be sent to the LHD that has authority to implement the program at the local or county level.

If the application is incomplete, the licensee will be informed by letter, phone call, fax, or a combination of the three requesting the missing information. No further action will be taken with regard to processing until all relevant information is received.

Step 7: At the same time the application packet is sent to MDEQ (Step 4 above), the licensee shall send notice of the application that includes the items listed under Sec. 4.3.2.1 to 4.3.2.4 to the following departments or agencies:

- Certified LHD that has jurisdiction.
- The clerk of the city or township where the site is located.
- Land owners whose land or parcel is contiguous to the proposed disposal site or would be contiguous except for the presence of a highway, road, or street.
- Land owners whose lot or parcel is within 150 feet (if disposed by injection) or within 800 feet (if disposed by surface application).

4.4.2 LHD Responsibilities

Detailed responsibilities are outlined and described in the contract document titled "Agreement with Local Health Departments Appendix E." This can be accessed on the MDEQ Septage Program website at www.michigan.gov/deqseptage under Local health department Information. This involves LHDs that have chosen to participate in the Septage Program. In counties not under contract, MDEQ provides these functions directly.

Step 1: On the receipt of the application packet from MDEQ, the LHD is expected to review the contents of the application packet.

Step 2: If satisfied, MDEQ expects the LHD to contact the licensee and schedule an inspection of the septage truck(s) and land site(s), if applicable.

If not satisfied due to missing item(s) or other issues, the LHD will contact the MDEQ as soon as possible for clarification and initiate action for inspection. It is preferred that the LHD contacts the MDEQ about an incomplete application in writing (letter, e-mail, or fax) for proper documentation. A phone call may also be made concerning minor clarifications.

Step 3: A site evaluation shall be conducted as stated in Section 4.4.3 of this document.

Step 4: After completion of the site evaluation or inspection, the LHD is expected to act on the following items:

- Make a recommendation.
- Sign the inspection checklist.
- Sign the appropriate section of the application form(s) EQP-5836 and/or EQP 5837 for new land sites and/or trucks.

Step 4: Send the signed application form(s), if applicable, vehicle and land site inspection checklists to MDEQ. It is recommended that the inspection checklists are sent to the MDEQ in a timely manner (30 days or less from the date of initial annual routine inspection or reinspection, if applicable).

4.4.3 Land Site Evaluation

Presite Visit Preparation

- Gather the items listed under Section 4.3.2.1 to 4.3.2.12.
- Review the information.
- Determine the dominant soil series and note the characteristics (e.g., soil textural class, drainage, water table, etc.) associated with the series using the official USDA/NRCS soil survey of that county.
- Other tools not listed.

Site Visit

- Determine whether information from the items listed above matches what is at the site.
- Make adjustments where applicable.
- For soils, use soil test pits and/or auger borings to determine soil characteristics (e.g., soil textural class, soil color, mottling, water table, etc.)
- Document the observations.
- Use the land site inspection checklist.

4.4.4 MDEQ Responsibilities

Details of MDEQ's responsibilities are stated in the contract document titled "Agreement with Local Health Departments Appendix E." This information can be accessed in the MDEQ Septage Program website.

Step 1: Upon receipt of the application packet and inspection packet from the LHD, the MDEQ will review the documents for completeness of the inspection.

Step 2: If satisfied, it will authorize the issuance of the appropriate license and/or sticker, in a timely manner.

If not satisfied, MDEQ will contact the LHD and/or licensee for additional information.

4.5 Land Site Identification Number (Site I.D) and Field Identification Label (Field ID)

4.5.1 Site Identification Number (I.D)
Each land site, when authorized by MDEQ, is assigned a numerical identification number (e.g., 1, 2, 3, etc.) This number shall be used in all correspondence involving the land site including, but not limited to, inspections (annual, reinspection) and complaints. This information can be accessed in the MDEQ Septage Program website.

4.5.2 Field Identification Label
If there is more than one field within a land site, the licensee can use alphabetical letters (A, B, C, etc.) to identify each field. Once identified, these letters will be maintained and used in all correspondence including, but not limited to, inspections (annual, reinspection) and complaints. The licensee shall inform MDEQ in writing in a timely manner when field identification labels change or if additional labels are assigned to additional fields within a land site.

4.5.3 Field Boundary Identification
Identify boundary of the land site or field by marking corners of the land site or field, unless already identified or marked naturally with tree lines, other vegetation, fence-rows, or roads. Examples of other suitable boundary markers include flags and orange cones. Marking the corners by longitude and latitude using a GPS unit is highly recommended.

4.5.4 Land Site Address
Where a permanent address to a land site is available, it will be used to identify the site in all correspondence involving the site. Where a permanent site address is **not** available, an approximate/temporary site address will be used in all correspondence involving the site.

4.6 Number of Land Sites and Fields

4.6.1 Land Sites
Maximum Number: There is no maximum number of land sites a licensee can use. The licensee can have as many land sites as can be effectively managed, provided they are MDEQ authorized.

Minimum Number: For a licensee who intends to land apply, the minimum number is one.

4.6.2 Fields
Maximum Number: There is no maximum number of fields within a land site.

Minimum Number: The minimum number of fields is **TWO*** within a land site, except where a licensee may have only one field where the land application is seasonal and it alternates with taking all septage to a wastewater treatment plant or receiving facility.

**** This means that the minimum number of composite soil samples to be taken and analyzed by any licensee is TWO.***

Chapter 5
Land Site Management Practices

5.1 Land Site Management Calendar (Cropping Plan)

This is the total of all management operations such as tillage (disking, injection), cropping practices, application of septage, lime, fertilizer, and other practices on MDEQ approved land sites during a 365-day period.

The Land Site Management Calendar (Cropping Plan) chart is given in Appendix C_1.

A cropping plan for each field within a land site will include, at the minimum, the following information:

- Septage Business Identification
- Site Identification
- Soil Series
- Soil Sampling Date
- Phosphorus Level (soil fertility test)
- Type of Crop
- Crop Planting and Harvest Dates
- Agronomic Application Rates
- Erosion Control Plan
- Crop Use (human or animal consumption)
- Winter Disposal Plan
- Beginning and end period of septage application.

See Appendix C_1, C_2, and C_3 of Land Site Management Calendar (Cropping Plan) forms for details.

Note: This is the plan or design submitted by the licensee showing how the MDEQ authorized land site will be used for the land application of septage. This is a proposed plan. It may change. After submitting the plan, licensee shall inform the MDEQ in a timely manner about any changes.

5.2 Agronomic Application Rate (AAR)

The AAR is the annual amount of septage waste that supplies the nitrogen needs of the crop or vegetation for optimal growth without leaving excess nutrients that may contaminate surface and/or groundwater.

The following factors are considered in determining the AAR for a particular crop:

- Type of crop or vegetation.
- Expected yield of the crop.
- Nitrogen content of septage.
- Nitrogen from other sources such as chemical fertilizers and from previous historical site use such as manure.
- Nitrogen requirement of the crop.

5.2.1 Type of Crop

Crops need nutrients for good growth and yield. The amount of septage to be land applied depends on the type of crop because crops have different nutrient requirements.

5.2.2 Expected Yield of the Crop

The greater the expected yield, the greater the amount of nutrients needed to support the yield. Since septage supplies nutrients, one should expect that the amount of septage applied per acre will increase as the nutrient requirement increases. Historical 3- to 5-year certified or properly

documented yield data can be used in calculating what yield to expect so a proper AAR can be calculated. The crop yield data for counties in Michigan for some years are issued by the USDA National Agricultural Statistics Service[11].

5.2.3 Nitrogen Content of Septage

The concentration of nitrogen in domestic septage is given as 0.0026 lbs N/gal. This value is obtained from USEPA Part 503[13, 14, 15, 16].

5.2.4 Nitrogen from Other Sources

Other sources of nitrogen, such as chemical fertilizers and previous crops, should be credited against nitrogen recommendations before the AAR is calculated. The amount of septage that shall be land applied depends on the amount of nitrogen contributed from the other sources. Nitrogen contributions from previous crops in a rotation are shown in Table 5. Nitrogen legume crop credits from the most current issue of the MSUE bulletin[20] can be used to calculate the AAR.

Table 5. Nitrogen Credit for N-responsive Crops Grown in Rotation with these Crops[20]

Previous Crop	N Credit (lb/ac)
Alfalfa, established	40 + (% stand*)
Alfalfa, seeding	40 + 0.5 (% stand)
Clover, established	40 + 0.5 (% stand)
Clover, seeding	20 + 0.5 (% stand)
Trefoil, established	40 + 0.5 (% stand)
Barley + legume	30 + 0.5 (% stand)
Oats + legume	30 + 0.5 (% stand)
Wheat + legume	30 + 0.5 (% stand)
Dry edible beans	20
Soybeans	30
Grass hay	40

* Percent (%) stand = the percent of the total vegetative cover occupied by legume plants; estimate the percentage visually or count the number of legume plants per square foot. 1 plant/sq ft = 20% stand; 2 plants/sq ft = 40%, etc., up to 5-6 plants/sq ft = 100% stand.

5.2.5 Nitrogen Requirement

The nitrogen requirement is the amount of nitrogen required by a crop for optimum growth in 365 days.

Calculating the Nitrogen Requirement

The nitrogen requirement of a crop can be determined by either of two ways:

- Nutrient removal per unit yield.
- Nutrient recommendation based on experimental field testing and soil testing.

The discussion that follows will be based on nutrient removal. Nutrient requirements based on experimental field testing and soil testing may be considered at a later date with additional training on soil sampling and soil sample information.

Nitrogen Requirement (lb N/ac) = Expected Yield x (Nutrient Removal/unit yield)

Example:
Expected Yield of corn (grain) = 140 bu/ac
Nutrient (nitrogen) Removal = 0.9 lb N/bu (Appendix D)[20]
Nitrogen Requirement (lb/ac) = 140 bu/ac x 0.9 lb N/bu = 126 lb N/ac

5.3 AAR Calculation
The following formula is used for AAR calculation:

$$\text{Agronomic Application Rate (gallons/acre/year)} = \frac{\text{Nitrogen Requirement of the Crop}}{0.0026}$$

Where:
Nitrogen requirement of the crop or vegetation is for 365-day period.

See Section 5.2.5 above for the calculation of the nitrogen requirement.

See Section 5.2.3 for the nitrogen content of septage, that is, 0.0026 factor.

See Appendix E for an example calculation of AAR.

The rate of domestic septage that is land applied shall not exceed the annual AAR.

The AAR calculated using this formula will likely need to be adjusted downward if the following apply:

- The predominant type of domestic septage is portable toilet septage.

It is reported that portable toilet septage can be four to six times more concentrated than regular domestic septage[13]. This is not considered in the formula above. The AAR calculated above may be reduced four or six fold if portable toilet septage is the predominant septage that is land applied.

- The type of soil is organic instead of mineral soil.

Organic soils have about 2 times more nitrogen than regular mineral soils[1]. In organic soils, the AAR may be reduced two fold.

Low Strength Septage Waste
Some septage waste may be regarded as low strength waste such as in holding tanks. The AAR calculated using the formula above may be adjusted upward in low strength septage waste where that is the only or predominant septage waste pumped. However, for this upward adjustment to be made, the hauler is expected to submit verifiable laboratory analysis of septage for at least three loads spread over a period of time. The results are expected to show that it is less concentrated with regard to nitrogen than the factor used in the AAR calculation above.

5.4 AAR Options
There are two options (A & B) of agronomic application rates available to land managers to use.

5.4.1 Option A – Basic AARs
This is a basic option where a licensee or land manager uses the recommended precalculated AAR depending on the crop type. These are conservative recommendations based on four criteria such as:

- Crop type.
- Crop removal[20].
- Nitrogen recommendations[20].
- Average crop yields in a typical mineral soil.

These are rates typically designed for soils at land sites within Soil Group 1(SG 1) as stated in Sec.3.1.4 but may be used at land sites with soils in other Soil Groups.

The table for Option A is shown in Appendix F.

5.4.2 Items to be Submitted for Review in Option A Category

- Completed Land Site Management Calendar (Cropping Plan) form that includes AAR and Crop type.
- Soil test report (annual) for each field in each land site.
- Erosion control plan.
- Crop Use.
- Basic site plan for current cropping year.
- Winter disposal plan.
- Other.

5.4.3 Option B – Advanced Agronomic Application Rates

Option B is considered to be a more advanced option than Option A. This option can be used by licensees or land managers who want to land apply septage at rates greater than the rates recommended in Option A.

Worked examples, calculation worksheet and explanation of this option are available in Appendix G_1 and G_2.

In this option, there is no precalculated AAR. The land manager calculates:

- Nitrogen requirement calculation as shown in Section 5.2.5.
- AAR based on the formula stated in Section 5.3.

5.4.4 Items to be Submitted for Review in Option B Category

- Completed land site management (Cropping Plan) form that includes AAR and crop type.
- AAR calculations.
- Three- to 5-year certified or properly documented records of crop yields at each land site/field.
- Crop use.
- Soil Group (SG).
- Septage analysis (may be required in some circumstances).
- Soil test report (annual) for each field in each land site.
- Other nitrogen sources such as chemical fertilizers or manure, if applicable.
- Erosion control plan.
- Basic site plan.
- Other.

5.5 Managing High Phosphorus Levels at Land Sites - What to do When Phosphorus Level is High

Managing phosphorus levels at land sites is important. Phosphorus deficiency can lead to stunted plant growth, and poor plant growth will lead to poor nutrient utilization in the soil. Excess phosphorus application using septage, manure, or chemical fertilizer can lead to phosphorus accumulation in soil and increased risk of losing phosphorus to surface waters.

Recommended Steps

5.5.1 Know the Phosphorus Level

Determine the phosphorus level at your land site by conducting soil tests. Make sure that soil samples are properly taken. Refer to Appendix A about how to take soil samples. Take more than one composite sample if soil variability at the site is present.

5.5.2 Cropping Plan Redesign

When the phosphorus level is at 200 lb/ac (100 ppm) or greater, but still less than 300 lb/ac (150 ppm), nutrient management should focus on phosphorus instead of nitrogen. The land application of phosphorus sources including septage should be discontinued. Crops that are good phosphorus removers from soil such as alfalfa, bromegrass, orchardgrass, timothy, or sorghum-sudangrass should be grown to help remove phosphorus from the soil. In general, the largest nutrient removals are achieved using legumes and perennial grasses that are cut frequently in their early stages of growth[12].

5.5.3 Monitoring and Evaluation

Test the soil annually to evaluate the phosphorus status. High phosphorus level in soil cannot be reduced overnight and it may take several years to notice a decline in the soil phosphorus level.

5.5.4 Affecting Factors

The degree and rate of phosphorus reduction depends on a number of factors including, but not exclusive to:

- Soil pH.
- Type of soil.
- Type of crop.
- Health of crop.
- Amount of phosphorus that can be removed by crop harvest.
- Nutrient balance of essential macro and micro nutrients.
- Management (how the crops and soils are treated).

Consult Appendix D for additional information about field crops and their ability to remove phosphorus in soil.

5.6 General Soil Management Practices at Land Sites

Septage waste is required to be land applied uniformly at agronomic rates and not “dumped.” Uniform application cannot be achieved when unacceptable soil management practices are adopted by those who land apply septage. Some good and bad management practices and their effects are summarized in Table 6.

Table 6. Practical Management of Soils.

Bad Practice	Good Practice
Practice: Haphazard movement of septage applicator truck all over the field under wet, sometimes saturated, or snow-covered conditions in fall, winter, and spring.	Plan septage applicator truck movement along defined paths in the field when the soils are not wet, saturated, or snow covered.
Frequent trips to the same field per day or week.	Reduce number of trips to the same field per day or week.
No grasses and legumes in the rotation of crops for improved nutrient recycling, e.g., nitrogen and phosphorus.	Introduce grasses and legumes into the rotation of crops at some point to improve nutrient recycling. e.g., nitrogen and phosphorus.
Little or no erosion control plan at land site.	Adopt erosion control plan suitable for the land site.
No uniform septage application over the field.	Apply septage uniformly using splash plate or other device over the field.
Effects: Soil compaction.	Reduction of soil compaction.
Destruction of soil structure.	Improvement of soil structure.
Reduction of pore space.	More pore space with air and water.
Poor or stunted crop growth.	Good crop growth.
Loss of soil particles and septage attached to them.	Reduction of soil loss and septage from land site.
Poor growth » lower crop yields » lower agronomic application rate.	Good growth » higher crop yield » higher agronomic application rate.

5.7 Soil Management in Winter

In Michigan, soils are wet, saturated, snow-covered, or frozen during the winter months. These conditions make it difficult to apply septage without damaging soil structure and possibly causing runoff of the septage from the site.

5.7.1 Frozen Field Condition

*<u>Reminder</u>**:** Effective October 12, 2006, land application of septage when the soil is frozen is not permitted.*

5.7.2 When the Soil is not Frozen

Land application of septage when the soil is not frozen is still permitted in fall or winter as long as incorporation or injection is possible. However, it is recommended that land application of septage during the winter months is avoided or significantly reduced.

5.7.3 Winter Plan (For those that will land apply during winter months).
DEQ approved written plan is needed when land applying septage during the winter months. Submit a site plan to the DEQ that contains the following:

- Location of land site where septage will be applied.
- Number of acres.
- Soil Group (Dominant Soil Textural Class).
- Percent slope.
- Intended maximum volume (in gallons) of septage that will be applied.
- AAR.
- Method of septage application.
- Erosion control plan.
- Standard isolation distances.

The plan shall be submitted to MDEQ for review and approval before land applying in winter (December 21 through March 21)

5.8 Some General Land Site Management Principles.
This section focuses on various practices that can be adopted to keep land applied septage waste in the field where it is applied.

5.8.1 Soil Group
Somewhat coarse-textured soils such as sandy loams are easier to manage than somewhat fine-textured soils such as clay loams under wet conditions. The septage applicator vehicle is likely to get stuck in the field primarily due to wetness and soil type. The possible effects of what can occur when soils are tilled under adverse weather conditions are shown in Table 6.

Recommended Action**:** Know the type of soil at the land site. If you do not know, check the county soil survey, MSUE County agents, soils consultants, or other resource materials.

5.8.2 Erosion Control Methods at Application Land Sites
Septage applied to soil will tend to move away from the point of application, especially for surface applied septage. The degree of septage movement away from the point of application depends on the following factors:

- The quantity of septage applied.
- The viscosity (thickness) of septage.
- The uniformity of septage application.
- The type and thickness of vegetative cover.
- Time of year and duration of rainfall.
- Soil type.
- Slope of the land.
- Soil moisture at the time of application.

Septage contains pathogens, nutrients, metals, and other pollutants that can adversely affect human health, wildlife, and the environment if it is not managed in accordance with state and federal laws. In order to reduce the movement of soil and septage waste from application sites to adjoining properties and waters, it is essential to reduce the runoff of surface water (rain and melting snow). There are methods that can be used to control soil erosion. These include, among others, vegetative border strips, cover crops, and tillage operations[21].

5.8.2.1 Vegetative Border Strip

It is highly recommended that a border strip consisting mainly of grasses, 30 feet wide (minimum), be planted at the lowest borders of the land sites across the direction of water flow as shown in the diagram below.

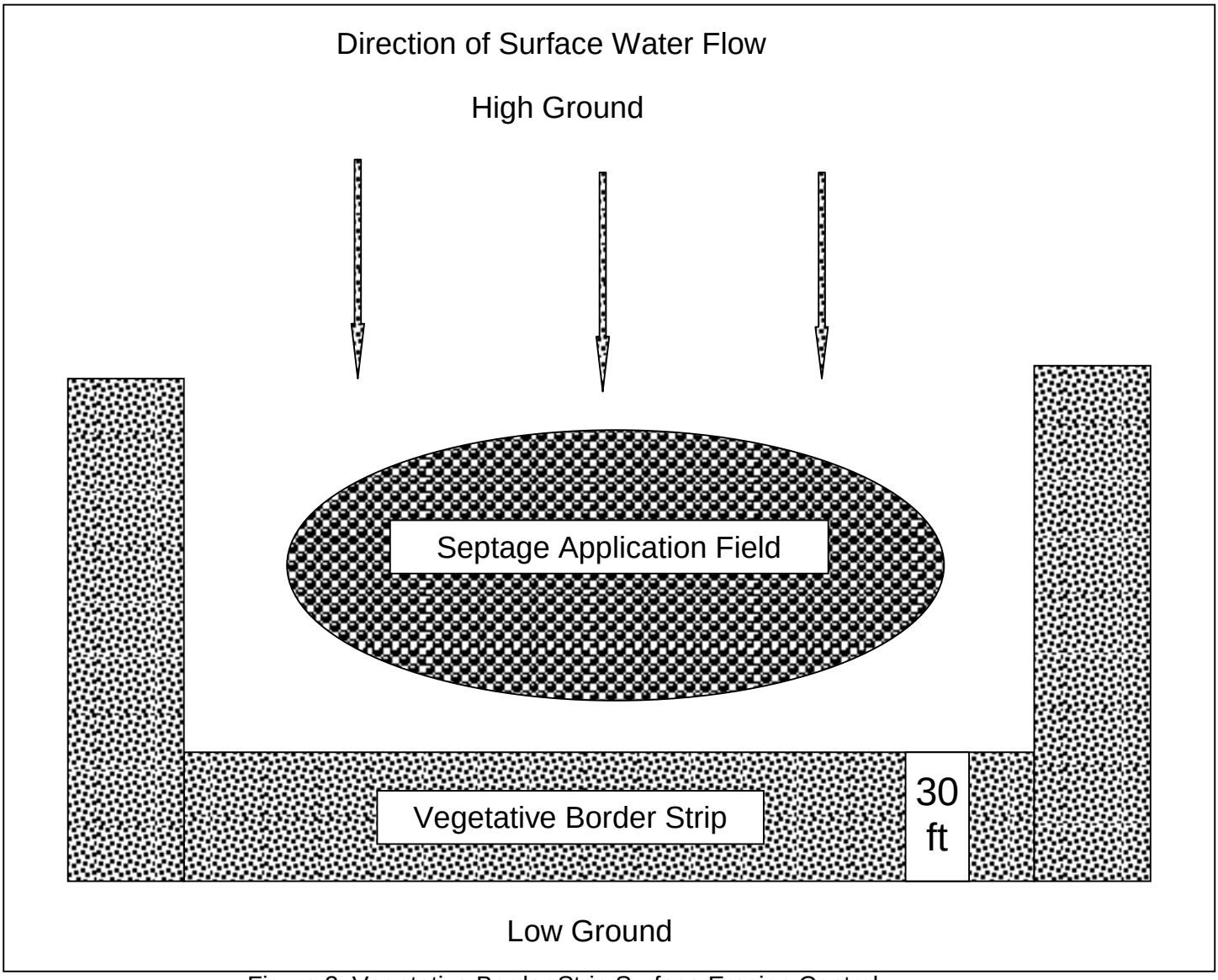


Figure 2. Vegetative Border Strip Surface Erosion Control.

5.8.2.2 Cover Crop

Erosion can also be controlled by a cropping plan that includes cover crops that are planted perpendicular to the surface water flow from the septage application field as shown below. Forage crops such as grasses and legumes are effective erosion control crops.

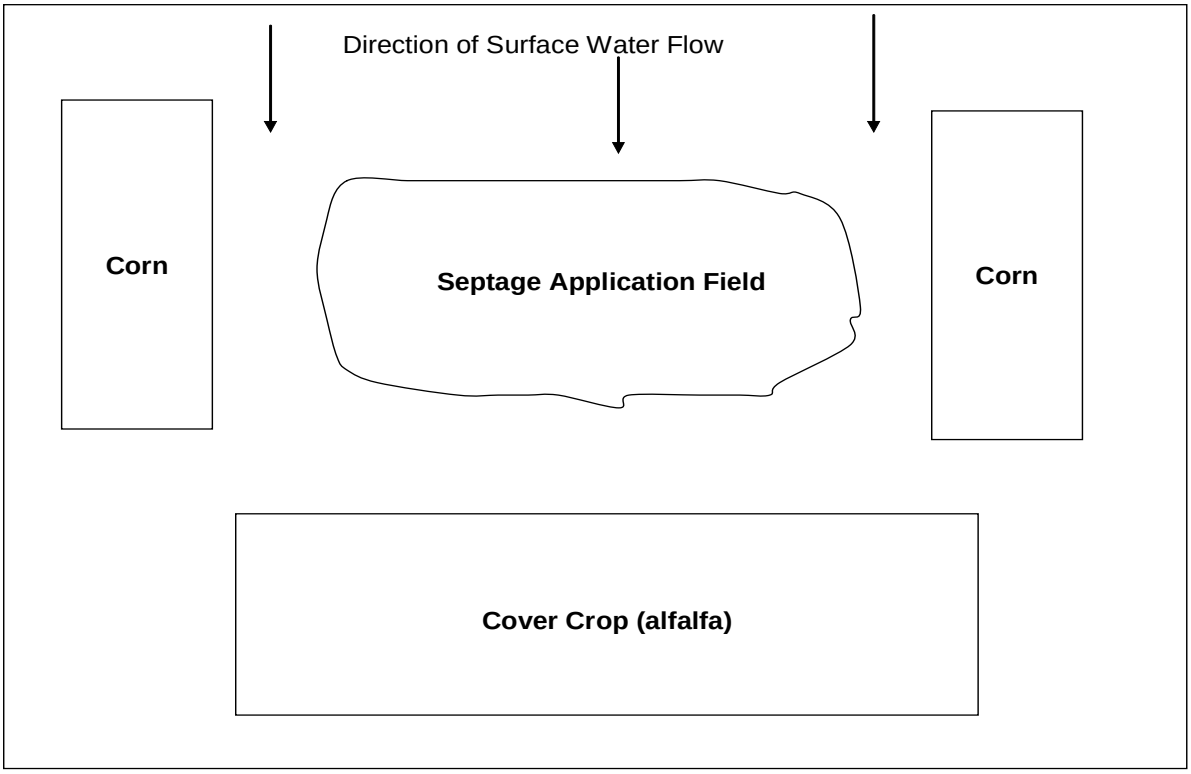


Figure 3 Surface Erosion Control Using Cover Crop and Other Crop Design

Protecting Active Fields without Crops or Vegetation: When septage has been applied to any portion of your land site, and there is no plan to apply any additional septage till the next season, seed that portion with grass as a way of controlling wind and/or water erosion. Grass seeds may even be added to the septage in the final run over the field to reduce the number of traffic trips to the field. Protecting the septage application site from wind and water erosion at any given opportunity is a good land management practice.

When grasses are grown for erosion control purposes, they do not have to be cut or harvested. However, if they are grown as part of nutrient recycling, they will need to be grazed or cut for hay. If they are grown for both, they will need to be cut during the most active growing periods of the cropping year. Crop and grazing restrictions from the USEPA are stated in Tables 11 and 12 of Chapter 7 of this document.

5.8.2.3 Tillage Operations

It is highly recommended that surface applied septage waste be incorporated and injected septage waste be done perpendicular to the slope. This will reduce the potential for septage runoff.

Recommended Action: Determine the flow of water from the application site. Run the septage applicator and incorporation vehicles perpendicular to the direction of flow as shown in Figure 4.

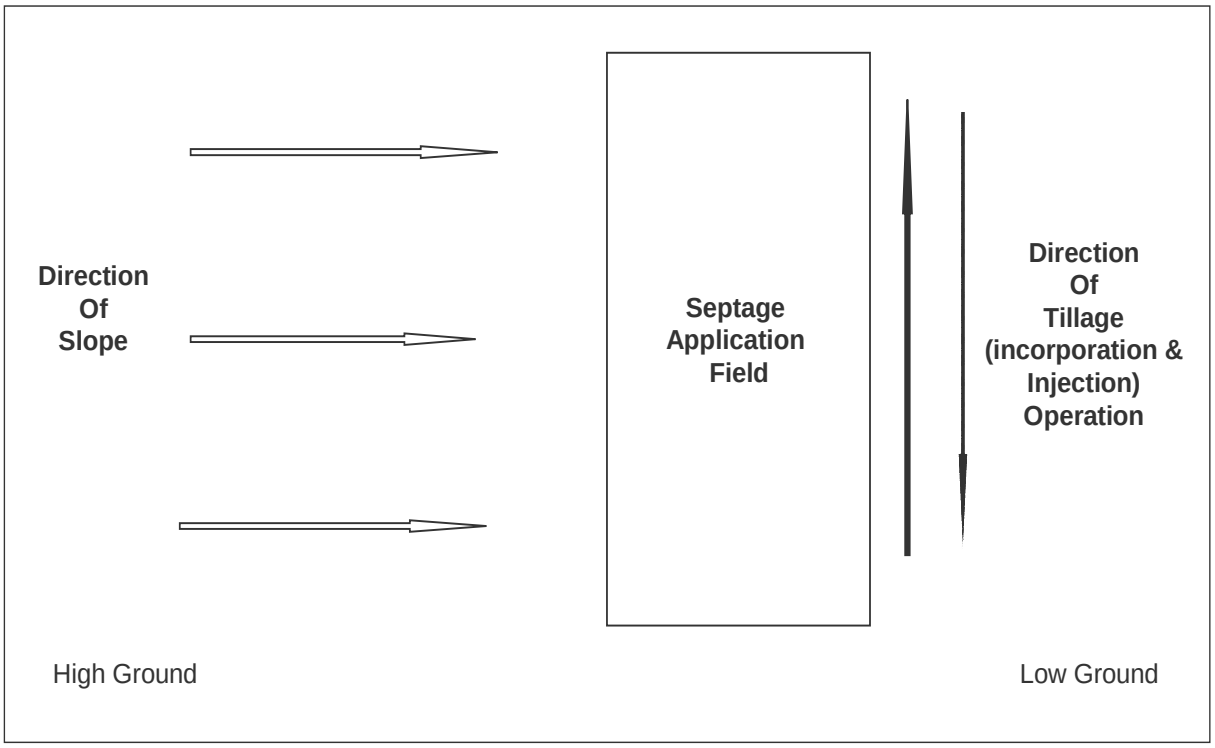


Figure 4 Direction of Septage Application in Relation to Slope

5.8.2.4 Other Methods

Other approved methods of erosion control can also be used. The key point is to reduce, as much as possible, the movement of soil particles with septage from the application site to adjacent areas.

Note: These are recommendations for licensees that adopt Option A or B. However, if evidence of surface water movement and accompanying soil erosion from a land site is observed during a site visit for annual, follow up, complaint, or other activity, the licensee may be required to implement an erosion control plan at the site.

Chapter 6

Septage Management at Land Sites

6.1 Septage Application Methods

There are two main methods of land applying septage waste -- surface application and subsurface injection. For both surface and injection application methods, uniform application and control of daily hydraulic application rates are important and necessary.

Uniform application of septage: To attain uniform application rates, use of a splash plate, reverse funnel, or other mechanical device is recommended for surface appliers. For injector appliers, all injection knives and discharge tubes, etc., should be evenly spaced and the septage prescreened to prevent clogging. A one-unit injection knife is not recommended.

Daily hydraulic application rate: This is the rate of application per day on the same field. Excessive application per day may result in serious hydraulic problems and soil structure may be severely damaged. Destruction of soil structure may limit infiltration of the water contained in septage into the soil and increase the potential to run off the application site.

In general, the less permeable the soil is and the shallower the depth to water table, the lower the rate of daily septage application.
Make sure that the application vehicle is calibrated properly to ensure even distribution of septage. Limit the number of gallons applied to such a site to ensure infiltration of the water contained in the septage. This will prevent ponding.

Restricted Access: Includes posting with no trespassing signs and simple fencing. Site remoteness may be considered on a case by case basis.

A good septage management practice at any land application site should consider the following:

- Soils, characteristics, and management.
- Crops, characteristics, and harvesting restrictions.
- Isolation distances.
- Agronomic application rates.
- Erosion control.
- Odor control.
- Weather conditions before, during, and after application.
- Restricted access notice.

6.1.1 Surface Application

Septage is applied on the surface of the land. For sites with little or no planted crop or vegetation, the surface applied septage shall be incorporated into the soil within 6 hours of application (see Table.9). Sites without actively growing planted crops are considered fallow land. Lime-stabilized septage may be surface applied to fallow land and mechanically incorporated within 48 hours (see Table 9). For sites with actively growing planted crops or vegetation such as field crops, row crops, or pasture, septage can be surface applied to existing vegetation without incorporation provided it is lime-stabilized before application.

In order to achieve uniform application at agronomic rates, a splash plate, reverse funnel, or other mechanical device needs to be utilized on the rear discharge end of the applicator vehicle. The width of spread of septage on the ground should be from 4 ft to 9 ft or more and a reverse funnel may be utilized (see Fig.5).

Figure 5. Surface Application of Septage.

6.1.2 Injection Application

Septage can be applied to soil using injection knives (see Fig.6). The depth of injection may range from 8 inches to 12 inches.

Figure 6. Subsurface Injection of Septage.

6.2 Septage Applicator Vehicle Calibration

Equipment used in septage application needs to be calibrated. This is to ensure that the correct amount of septage per unit area is applied uniformly at agronomic application rates. Equipment calibration is important in both surface and injection methods of septage application.

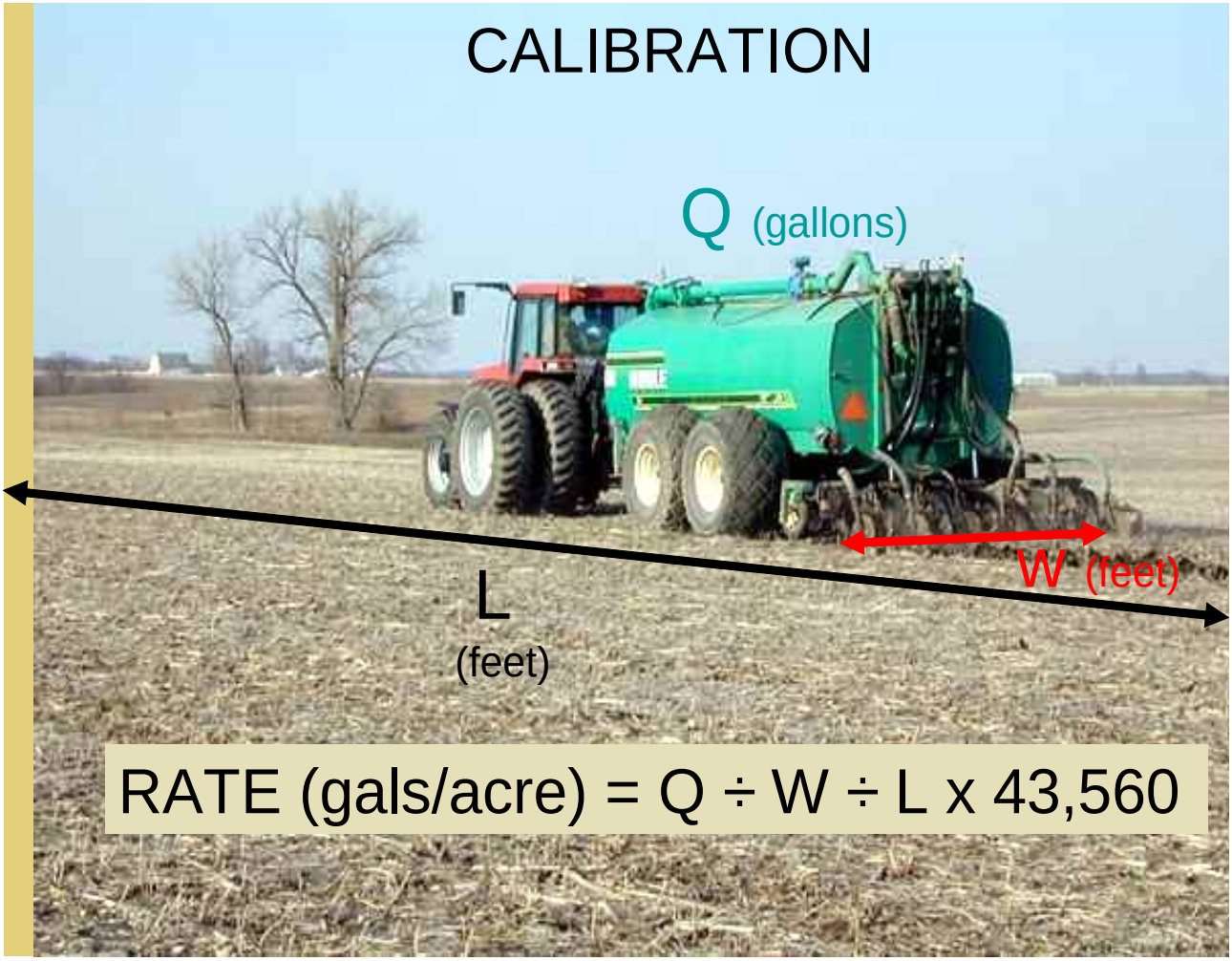


Figure 7. Septage Applicator Calibration.

The following formula may be used:

Rate (gal/ac) = See above formula

Where: Q = Quantity (gallons) of septage in the application truck tank.
W = Width of spread of septage on the ground.
L = Length of run or travel.

Note: *The rate of application (RA) from the truck is not the same as the AAR. While RA deals with the quantity of septage applied during a trip to the land site, AAR deals with the quantity of septage applied over a period of time to the same land site area by one or more passes.*

6.3 Practical Septage Waste Management

Table 7. Practical Septage Waste Management at Land Sites.

Bad Practice	Good Practice
Practice: Septage still left on soil surface due to improper incorporation or injection, e.g. ,ponding. Ponding: Liquid on soil surface after: 1 hour - Injection 6 hours – Surface Application of septage to site with slope greater than 6% (surface) or 12% (injection). Application of septage in the same direction of the flow of water.	After incorporation or injection, get down from vehicle and evaluate operation before leaving site. Disc again to incorporate properly. If ponding is occurring, adjust injector arm so it can penetrate deeper into the soil. Measure slope if not sure. Apply to slope not greater than 6% (surface) or 12% (injection). Apply septage and incorporate or inject perpendicular to slope.
Effects: Septage is likely to be carried by storm water runoff or melted snow to adjacent properties, roads, or waters. Too much septage applied to the field can also result in runoff.	If septage is: ☙ Properly incorporated or injected, ☙ Applied at proper slopes, ☙ Applied across (or perpendicular to) slopes, and ☙ Followed by seeding at the proper time it is less likely to be carried away from the application site to neighboring areas.

6.4 Food Establishment Septage (FES)

Material pumped from a grease interceptor, grease trap, or other appurtenance used to retain grease or other fatty substances contained in restaurant wastes and that is blended into a uniform mixture, consisting of not more than one part of that restaurant-derived material per 3 parts of domestic septage, prior to land application or disposed of at a receiving facility.

Mixing Ratio: Food establishment septage shall be mixed with regular domestic septage in no greater than 1:3 ratio, that is, one part of FES to three parts of domestic septage.

1 Part FES + 3 Parts of Domestic Septage = Septage/FES Mixture

Septage mixed as indicated above may be land applied. Mixing can occur in the septage waste storage facility or in the tank.

Soil Test for FES Application

Septage waste shall not be land applied unless soil testing has been conducted in that location in accordance with 40 CFR Part 257.3 to 257.5. This section requires testing that includes cadmium and polychlorinated biphenyls (PCBs) among other parameters (see Part 117 and 40 CFR Part 257 for details.

6.5 Septage Waste Screening

Septage can be screened or put through a grinder before land application. There are several methods that are available to screen or grind septage waste. Licensees should select the method that is suitable for their operation and need. The screen size or grinding size of the solid particles is shown in Table 8.

Table 8. Septage Waste Screening and Particle Size

Septage Screening Waste Screening and Particle Reduction Method	Septage Screen and Waste Particle Size
Screening	½-inch mesh or less or Slats with gap of 3/8- inch or less
Grinding	½-inch or less

Screening Target Date: Effective October 12, 2006, all Septage applied to land shall be screened or put through a grinder before application.

6.6 Septage Treatment Methods

Several methods are available and used for septage waste treatment. These include, among others, alkaline (or lime) stabilization, composting, air drying, aerobic, and anaerobic digestion. Only alkaline stabilization is discussed in this guidance document.

6.6.1 Alkaline Stabilization

Typically, this stabilization involves mixing septage with lime (see Figure 8). The pH of the mixture shall be at least 12 and shall remain at 12 or higher for at least one-half hour prior to applying to land. The lime stabilization process shall be documented for review by regulatory inspector(s) at any time as allowed under the law. A Septage Stabilization Log is available in Appendix H for use by licensees. Lime stabilization is also a method of pathogen reduction and vector attraction reduction.

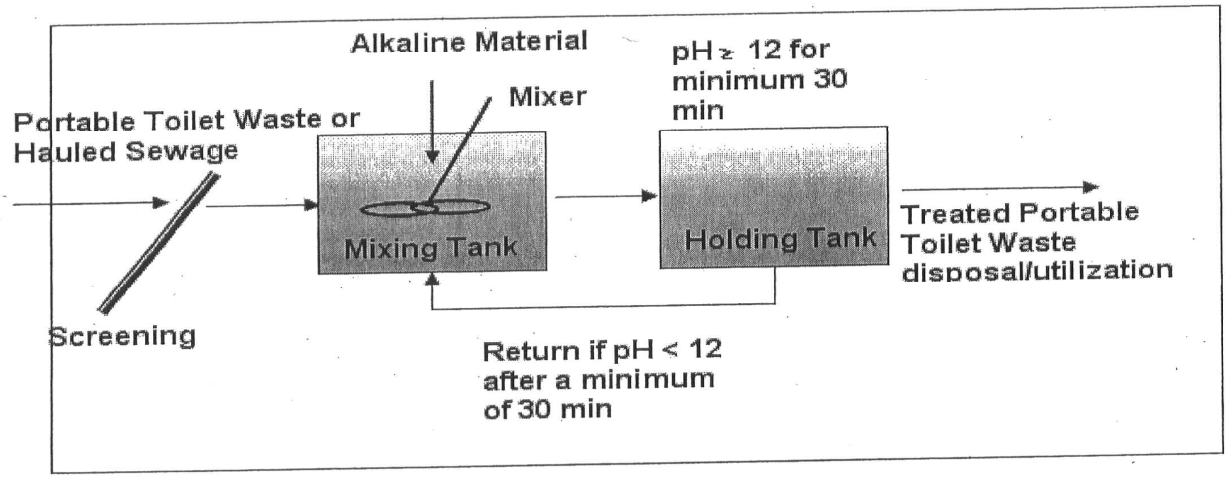


Figure 8. Alkaline Stabilization[5].

Basic Tools

If you lime stabilize septage waste for land application, the following tools are recommended and they should be available at the mixing location, storage site, or land application site:

- Alkaline material (hydrated lime or quicklime).
- pH meter (calibrated) or pH test paper (active test paper).
- Mechanical mixer.
- Container for mixing.
- Recirculation in tank.
- Sampler (container for sampling).
- Lime stabilization log (or record) book.
- Other tool(s) depending on your method of lime stabilization.

6.6.2 Septage Waste and Lime Stabilization

The treatment discussed in Table 9 below summarizes what to do with septage that is lime stabilized and septage that has not been lime stabilized with regard to fallow land and cropped land.

Table 9. Land Applying Septage Waste Not Lime Stabilized and Lime Stabilized Septage Waste.

Septage Waste Not Lime Stabilized	Lime Stabilized Septage Waste
Can be: Surface applied on fallow land followed by incorporation within 6 hours. Cropping to follow within one year after septage application.	Can be: Surface applied on fallow land followed by incorporation within 48 hours. Cropping to follow within one year of septage application.
Can be: Surface applied over scattered weeds or vegetation followed by incorporation within 6 hours. Cropping to follow within one year after septage application.	Can be: Surface applied over actively growing forage crops or vegetation without incorporation. It can also be applied early where row crops are planted without incorporation.
Can be: Subsurface injected on fallow ground. Cropping to follow within one year of septage application.	Can be: Subsurface injected early where row crops or vegetation are planted.
Recommendation: It is always a good practice to keep fallow ground covered, after the end of septage application, with cover crops and/or other control methods to reduce soil erosion before the next cropping year.	

Table 10. Pathogen Reduction and Vector Attraction Reduction Methods.

Pathogen Reduction	Vector Attraction Reduction
Lime stabilization	Lime stabilization
Site restrictions as per USEPA Part 503	Surface application followed by incorporation within 6 hours
	Subsurface injection

Record Keeping

The following records should be kept in the pump vehicle and/or business office and available for review by state and local officials:

- Location of land site.
- Number of acres of the land site/field.
- Quantity (in gallons) of septage applied per day in each field.
- Method of septage application.
- Whether septage was lime stabilized or not.
- Date of septage application.
- Time of septage application.
- Time of incorporation, if surface-applied.

See Appendix J for a sample of Land Application Volume Record.

Chapter 7

United States Environmental Protection Agency Rule 503

7.1 Introduction
Regulations were adopted by the USEPA in 1993 and 1994 (40 CFR Part 503). This part provides minimum requirements for the land application of domestic septage. In some instances, Michigan standards are somewhat more restrictive than USEPA Part 503. Each licensee that land applies septage in Michigan is required to follow the Federal Part 503 requirements and Michigan Part 117.

Key requirements of the USEPA Part 503 are:

- Part 503 authorizing the land application of domestic septage only.
- Determining the annual application rate.
- Pathogen reduction requirements.
- Vector attraction reduction requirements.
- Certification requirements.
- Restrictions on crop harvesting.
- Record keeping.

7.2 Domestic Septage
To meet the Federal Part 503 requirement, the septage that is land applied to a nonpublic contact site will be domestic septage only. Michigan Part 117 authorizes the land application of food establishment septage with certain restrictions.

7.3 Annual Application Rate and Nitrogen Requirement
In order to prevent the over application of nitrogen that may contaminate our waters, the nitrogen requirement of the crop will be determined. The land applier shall not apply more than what the crop needs for good growth and yield.

7.4 Pathogen Reduction
To meet the federal USEPA requirement, prescribed requirements need to be adopted to reduce disease-causing pathogens in the septage. Pathogen reduction alternatives 1 and 2 are given in Tables 11 and 12.

7.5 Vector Attraction Reduction
Septage attracts different kinds of vectors. Action must be taken to reduce vector attraction. Details of three vector attraction reduction alternatives are given in Table 13.

7.6 Certification Statement
The land applier shall certify that pathogen and vector attraction reduction methods have been met. An example of a certification statement is given in Section 7.9.

7.7 Crop Harvesting, Animal Grazing, and Site Access Restrictions
There are site restrictions involving the land application of domestic Septage. Details of site restrictions are given in Tables 11 and 12. A case example is shown in Section 7.9 of this manual.

7.8 Record Keeping
Land application records of septage waste should be kept for 5 years. The records may be requested for review by regulatory agencies at any time. What is required for recordkeeping is stated as a summary in Table 15.

Note: The licensee is advised to consult references 13 and 18 for details of Part 503.

7.9 Federal Standards for the Application of Domestic Septage

Table11. Pathogen Reduction Alternative 1.

PATHOGEN REDUCTION ALTERNATIVE 1[1] for Domestic Septage Septage (without additional treatment) applied to nonpublic contact sites
Domestic septage is pumped from the septic tank or holding tank and land applied without treatment, and <u>Crop Restrictions</u>: i) Food crops with harvested parts that touch the septage/soil mixture and are totally above ground shall not be harvested for 14 months after application of Domestic septage. ii) Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of domestic septage. iii) Animal feed, fiber, and those food crops that do not touch the soil surface shall not be harvested for 30 days after application of the domestic septage. iv) Turf grown on land where domestic septage is applied shall not be harvested for one year after application of the domestic septage when the harvested turf is placed on either a lawn or land with a high potential for public exposure, unless otherwise specified by the permitting authority. <u>Grazing Restrictions</u>: i) Animals shall not be allowed to graze on the land for 30 days after application of domestic septage. <u>Site Restrictions</u>: i) Public access to land with a low potential for public exposure shall be restricted for 30 days after application of domestic septage. Examples of restricted access include remoteness of site, posting with no trespassing signs, and/or simple fencing.
[1] You must meet either of the two pathogen reduction alternatives discussed in Alternative 1 or 2 (not both).

Table12. Pathogen Reduction Alternative 2.

PATHOGEN REDUCTION ALTERNATIVE 2[1] for domestic Septage (with pH treatment) applied to nonpublic contact sites
The domestic septage pumped from the septic tank or holding tank has had its pH raised to 12 or higher by the addition of material such as hydrated lime or quicklime and, without adding more alkaline material, the domestic septage remains at a pH of 12 or higher for at least 30 minutes prior to being land applied, and Crop Restrictions: i) Food crops with harvested parts that touch the septage/soil mixture and are totally above ground shall not be harvested for 14 months after application of domestic septage. ii) Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of domestic septage when the domestic septage remains on the land surface for 4 months or longer prior to incorporation into the soil. iii) Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of domestic septage when the domestic septage remains on the land surface for less than 4 months prior to incorporation into the soil. iv) Animal feed, fiber, and those food crops whose harvested parts do not touch the soil surface shall not be harvested for 30 days after application of the domestic septage. v) Turf grown on land where domestic septage is applied shall not be harvested for one year after application of the domestic septage when the harvested turf is placed on either a lawn or land with a high potential for public exposure, unless otherwise specified by the permitting authority. Grazing Restrictions: None Site Restrictions: None
[1]You must meet either of the two pathogen reduction alternatives in Alternative 1 or 2 (not both). Note, if you meet this pH 12 pathogen reduction alternative, you also meet vector attraction reduction in Alternative 3.

Table13. Vector Attraction Reduction Alternative 3.

VECTOR ATTRACTION REDUCTION ALTERNATIVE 3[1] For Domestic Septage Applied to Nonpublic Contact Land
VECTOR ATTRACTION REDUCTION ALTERNATIVE 1: Injection Domestic septage shall be injected below the surface of the land, AND no significant amount of the domestic septage shall be present on the land surface within one hour after the domestic septage is injected;
OR
VECTOR ATTRACTION REDUCTION ALTERNATIVE 2: Incorporation Domestic septage applied to the land surface shall be incorporated into the soil surface plow layer within 6 hours after application;
OR
VECTOR ATTRACTION REDUCTION ALTERNATIVE 3: pH Adjustment The pH of domestic septage shall be raised to 12 or higher by addition of alkaline material and, without the addition of more alkaline material, shall remain at 12 or higher for 30 minutes.
[1] You must meet vector attraction reduction alternatives 1, 2, or 3 – only one.

Table14.Case Example of Management of Untreated Domestic Septage.

CASE EXAMPLE Management of Untreated Domestic Septage
1. The untreated domestic septage is pumped directly into the truck's tank and hauled to a nonpublic contact site.
2. The domestic septage is injected below the land surface with no significant amount of domestic septage remaining on the land surface within one hour after the domestic septage is injected (vector attraction reduction alternative 1).
OR
2b. The domestic septage is incorporated into the soil surface within 6 hours after application to the land (vector attraction reduction alternative 2).
3a. If an animal feed crop like hay, a food crop like corn (that usually does not touch the surface of the soil), or a fiber crop like cotton is grown, a minimum wait of 30 days after application of the domestic septage is required before the crop may be harvested.
OR
3b. A minimum wait of 30 days after application of the domestic septage is required before letting animals graze the pasture.
OR
3c. If a food crop, like melons or cucumbers that touch the surface of the soil, is grown, a wait of 14 months after application of the domestic septage is required before that food crop may be harvested.
OR
3d. If you raise a food crop, like potatoes or onions that grow below the surface of the soil, a minimum wait of 38 months after application of the domestic septage is required before that food crop may be harvested. Additional examples of the different kinds of crops described in 3a to 3c are listed in Figure 6.
4. Public access to this nonpublic contact site (site with a low potential for public exposure) must be restricted for 30 days after application of untreated domestic septage. Examples of restricted access includes remoteness of site, posting with "no trespassing" signs, and simple fencing.
5. You must complete and sign the certification listed in Form #3 about meeting the pathogen and vector attraction reduction requirements.

Table15. Record Keeping.

RECORD KEEPING REQUIREMENTS
1. The location of the site where domestic septage is applied, either the street address, or the longitude and latitude of the site (available from the U.S. Geological Survey maps). 2. The number of acres to which domestic septage is applied at each site. 3. The date and time of each domestic septage application. 4. The nitrogen requirement for the crop or vegetation grown on each site during the year. Also, while not required, indicating the expected crop yield would help establish the nitrogen requirement. 5. The gallons of septage that are applied to the site during the specified 365-day period. 6. The certification shown in Table 16. 7. A description of how the pathogen requirements are met for each batch of domestic septage that is land applied. 8. A description of how the vector attraction reduction requirement is met for each batch of domestic septage that is land applied.

Pathogen and vector attraction reduction Certification Statement

This federal certification statement is required under 40 CFR 503 - Standards for the Use or Disposal of Sewage Sludge. Please note that this federal law includes septage as well.

State of Michigan licensed septage waste servicers must include this certification statement, signature, and date the statement is signed on every land disposal record form used to track the amount/volume of septage land applied at each MDEQ authorized disposal site. This includes every separate location that may be used on each site.

Table16. Certification Statement.

The certification statement found in 40 CFR 503, 503.17 (6)(b)(6) (Recordkeeping) shall read: I certify, under penalty of law, that the information that will be used to determine compliance with the pathogen requirements [insert either Sec. 503.32(c)(1) or Sec. 503.32(c)(2)] and the vector attraction reduction requirement in [insert Sec. 503.33(b)(9), 503.33(b)(10), or Sec. 503.33(b)(12)] was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment. _____ Signature Date (To be signed by the person designated as responsible in the firm that applies septage)

APPENDIX A

Summary of How to Take Soil Samples

Number of cores (or borings) to make one composite sample = 15 – 20.

Field (land) size area covered by one composite sample = 10 – 15 acres.
About 1- 2 cores (borings) per acre.
Mix cores (borings) in a clean pail to make composite sample.

Quantity of a composite sample to put inside sample container = About 1-2 cups.

Depth to sample = 6 - 8 inches (or tillage depth).

How often to sample = Once every year (Septage Program).

When to sample = Any time, but best when soil is not frozen or too wet. Sample at about the same time each year if possible.

Where to sample = Sample uniform areas to make a composite sample.
Delineate areas that look alike and get a composite sample from each area.

Avoid unusual spots such as manure or lime piles, near fences or roads, fertilizer bands, very low spots, etc.

Pattern of sampling = Zig-zag or "W-shaped" pattern across sampling area.

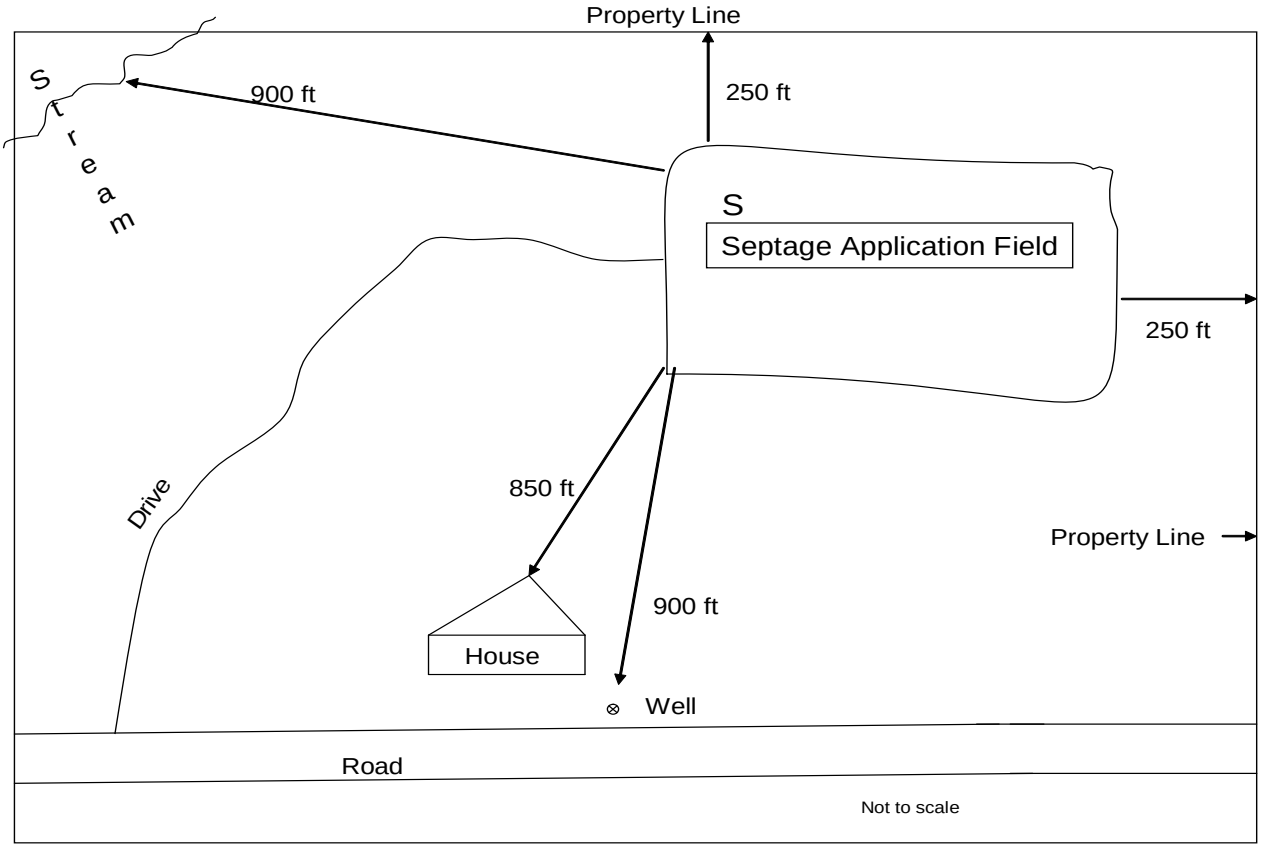
Tools to use = Soil sampling probe (best); soil auger; pointed shovel; plastic pail; sample box or bag.

Sample Identification: Identify sample box or bag properly (Your name, field [land] location and other requested information printed on the sample box or bag).

Where to send soil sample = MSU Soil & Plant Nutrient Lab or other commercial soil testing lab of your choice. *Samples for MSU Soil & Plant Nutrient Lab may be dropped off at the MSUE office nearest to you.*

You may consult references 6 and 9 for additional information about soil sampling and laboratory procedures in soil analysis. Furthermore, some of these references are also given on the Septage Program website at: www.michigan.gov/deqseptage under Information.

Appendix B Land Site Plan Example



FORM #1 LAND SITE MANAGEMENT CALENDAR (Cropping Plan) Appendix C_1

Business Name: _____ **Septage License #:** _____ **Cropping Year:** _____

Land Site Address: _____ Site **I.D #:** _____ Soil **Series** _____

City: _____ County**:** _____ **Twp:** _____ Section **of Land Site:** _____

Your Plan											
Oct.	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**
Field #: ___ Acreage ____ Phosphorus Level _____ lb/ac Agronomic Application Rate _____ gal/ac/yr											
Field #: ___ Acreage ____ Phosphorus Level _____ lb/ac Agronomic Application Rate _____ gal/ac/yr											
Field #: ___ Acreage ____ Phosphorus Level _____lb/ac Agronomic Application Rate _____ gal/ac/yr											
Field #: ___ Acreage ____ Phosphorus Level _____lb/ac Agronomic Application Rate _____ gal/ac/yr											

Crop Type and Use: **Erosion Control Plan Attached** ☐ **Yes** ☐ **No**

Use additional sheets as needed.

- **Soil Sample: Recommended period to take soil sample(s) for analysis is fall.**
- **Crops: Indicate approximate crop planting and harvest dates as shown in the examples.**
- **Septage Application: Indicate period to land apply septage, as shown in the examples, at rates not exceeding the annual agronomic application rate.**
- **No Septage Application: Period not recommended for septage application. Septage application during winter when ground is not frozen will need written plan about effective soil management.**

Winter Disposal Plan: ☐ **Wastewater Treatment Plant** ☐ **No Septage Pumping during winter**
(Check all that apply) ☐ **Land Application. Submit Written Plan** ☐ **Storage Facility**

Use one form for each land site. Note: There may be more than one field per MDEQ authorized land site.

FORM #1 LAND SITE MANAGEMENT CALENDAR (Cropping Plan) Appendix C_2

Business Name: John Doe Septic Service **Septage License #:** 00-00 **Cropping Year:** 2005/2006

Land Site Address: 9090 Septage Road **Site I.D #:** 1 **Soil Series:** Great Lake Series

City: No Pollution **County:** Tolerant **Twp:** Waste manager **Section of Land Site:** 5

Examples

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Site 1 Field A = 10 acres				**Phosphorus Level = 80 lb/ac**			**Agronomic Application Rate (AAR) = 38,000 gal/ac/yr**				
Soil Sample Septage Appl.		***No Septage Application***			***Septage Appl.***		***Corn(grain)***				
Site 1 Field B = 8 acres				**Phosphorus Level = 55 lb/ac**			**Agronomic Application Rate (AAR) = 23,000 gal/ac/yr**				
Soil Sample Winter Wheat					***Winter Wheat***					***Septage Application***	

Field Rotation Storage Facility/WWTP/No pumping
Two fields (A & B). Septage application followed by corn in Field A. Winter wheat followed by septage application in Field B.

Site # 2 = 15 acres	**Phosphorus Level = 110 lb/ac**	**Agronomic Application Rate (AAR) = 35,000 gal/ac/yr**
Soil Sample Brome & Septage	***No Septage Application***	***Septage Application over Bromegrass***

No Field Rotation Storage Facility/WWTP/No Pumping
One site with one field. Bromegrass planted. Septage application over bromegrass. Bromegrass harvested.

Site 3 Field A = 5 acres	**Phosphorus Level = 95 lbs/ac**	**Agronomic Application Rate (AAR) = 60,000 gal/ac/yr**
Soil Sample Septage Appl.	***Septage to Unfrozen Ground***	***Soybeans***
Site 3 Field B = 25 acres	**Phosphorus Level = 70 lb/ac**	**Agronomic Application Rate (AAR) = 23,000 gal/ac/yr**
Soil Sample Rye	***Winter Rye***	***Septage Application over Rye***

Field Rotation No Storage Facility/WWTP
Two fields (A & B) at one land site. Septage application followed by soybeans in Field A; Rye crop followed by septage in Field B
Use one form for each land site. Note: There may be more than one field per MDEQ authorized land site.

LAND SITE MANAGEMENT CALENDAR (CROPPING PLAN) Appendix C_3

Worksheet

Your Plan											
Oct.	**Nov.**	**Dec.**	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**

SITE #

Field #: ___ Acreage ____ Phosphorus Level _____ lb/ac Agronomic Application Rate _____ gal/ac/yr

Field #: ___ Acreage ____ Phosphorus Level _____ lb/ac Agronomic Application Rate _____ gal/ac/yr

SITE #

Field #: ___ Acreage ____ Phosphorus Level _____ lb/ac Agronomic Application Rate _____ gal/ac/yr

Field #: ___ Acreage ____ Phosphorus Level _____lb/ac Agronomic Application Rate _____ gal/ac/yr

Field #: ___ Acreage ____ Phosphorus Level _____lb/ac Agronomic Application Rate _____ gal/ac/yr

Appendix D Nutrient removal in harvest portion of several Michigan field crops.

Nutrient removal in harvest portion of several Michigan field crops.					
Crop		**Unit**	**N**	**P_2O_5**	**K_2O**
Alfalfa	(Hay)	Ton	45	13.0	50.0
	(Haylage)	Ton	14	3.2	12.0
Barley	(Grain)	Bu	0.88	3.28	0.25
	(Straw)	Ton	13	3.2	52
Beans (dry edible)	(Grain)	Cwt	3.6	1.2	1.6
Bromegrass	(Hay)	Ton	33	13	51
Buckwheat	(Grain)	Bu	1.7	0.25	0.25
Canola	(Grain)	Bu	1.9	0.91	0.46
Clover	(Hay)	Ton	40	10	40
Clover-grass	(Hay)	Ton	41	13	39
Corn	(Grain)	Bu	0.90	0.37	0.27
	(Stover)	Ton	22.0	8.2	32.0
	(Silage)	Ton	9.4	3.30	8.00
Millet	(Grain)	Bu	1.1	0.25	0.25
Oats	(Grain)	Bu	0.62	0.25	0.19
	(Straw)	Ton	13	2.8	57
Orchardgrass	(Hay)	Ton	50	17	62
Potato	(Tubers)	Cwt	0.33	0.13	0.63
Rye	(Grain)	Bu	1.1	0.41	0.31
	(Straw)	Ton	8.6	3.7	21
	(Silage)	Ton	3.5	1.5	5.2
Sorghum	(Grain)	Bu	1.1	0.39	0.39
Sorghum-Sudangrass	(Hay)	Ton	40	15	58
	(Haylage)	Ton	12	4.6	18
Soybean	(Grain)	Bu	3.8	0.80	1.40
Spelts	(Grain)	Bu	1.2	0.38	0.25
Sugar beets	(Roots)	Ton	4.0	1.3	3.3
Sunflower	(Grain)	Bu	2.5	1.2	1.6
Timothy	(Hay)	Ton	45	17	62
Trefoil	(Hay)	Ton	48	12	42
Wheat	(Grain)	Bu	1.2	0.63	0.37
	(Straw)	Ton	13.0	3.3	23

Source: Nutrient Recommendations for Field Crops in Michigan. MSU Extension Bulletin E-2904, 2004[16].

Appendix E

AGRONOMIC APPLICATION RATE (AAR) CALCULATION

The Agronomic Application Rate (AAR) can be determined by considering the following:

- Type of crop
- Expected yield of the crop
- Nitrogen content of septage (Given = 0.0026) Source: U.S EPA
- Nitrogen from other sources e. g., chemical fertilizers, manure.
- The nitrogen requirement of the crop.

$$\text{AAR (gallons/ac/yr)} = \frac{\text{Pounds (lbs) of Nitrogen Required for Crop Yield}}{0.0026}$$

Expected Yield (corn grain) = 120 bu/ac.

Nutrient removal factor* = 0.9 lb N/bu

Nitrogen Requirement = 108 lb N/ac (120 bu/ac x 0.9 lb/bu)

Nitrogen from other sources = 0 lb N/ac (Assumed in this example)
(e.g., chemical fertilizer, manure, previous crop)

Total Nitrogen Requirement = 108 lb N/ac

$$= \frac{108 \text{ lb N/ac}}{0.0026 \text{ lb N/gal}}$$

= 41, 538 gal/ac/yr or **42,000 gal/ac/yr** (rounded)

***** Nutrient Removal in Harvest Portion of Several Michigan Field Crops, MSU Extension Bulletin E-2904, 2004. (16)

Example: Corn (grain) = 0.90 lb/bu.

Appendix F
OPTION A

Agronomic Application Rates (AAR) For Selected Crops

Crop	Nitrogen Requirement* (Lb N/Ac)	Agronomic Application Rate AAR = N Requirement / 0.0026 (Gal/Ac/Yr)
Grass-Legume Mixtures Alfalfa Clover Soybeans Trefoil	160	60,000
Corn	100	38,000
Bromegrass Ochardgrass Timothy	90	35,000
Small grains Barley Buckwheat Millet Oats Rye Sorghum-Sudangrass Wheat	60	23,000
Other Crops and Tree Crops	Consult MSU Extension Nutrient Recommendations Guide.	

* Based on Nitrogen Recommendation, Nutrient Removal, and Expected Yield[20].

Winter Disposal Plan: ☐ **Wastewater Treatment Plant**
☐ **Storage Facility**
☐ **Land Application with a written plan {Sec. 11703 (1) (e)}.**

Reminders: Effective October 12, 2006, a person shall not surface apply septage to frozen ground. Effective October 12, 2006, before land application, domestic septage shall be screened through a screen of not greater than ½ -inch mesh or through slats separated by a gap of not greater than 3/8-inch.

Appendix G_1 and G_2
OPTION B

Agronomic Application Rates (AAR)

For Land Managers or Owners Who Will Apply Septage At Rates Greater than Basic Application Rates in Option A for each Crop Category.

Crop	Expected Crop Yield* (bu/ac, ton/ac)		Nitrogen Removal** (lb/unit yield)		Nitrogen Requirement *** (lb N/ac)		Nitrogen from Previous Crop**** (lb N/ac)		Nitrogen from Chemical Fertilizer***** (lb N/ac)	Total Nitrogen Requirement (lb N/ac)	Agronomic Application Rate AAR = N Reqd. / 0.0026 (gal/ac/yr) Max = 100,000
Example: Corn with No Nitrogen Contribution from Previous Crop (e.g., wheat) and Chemical Fertilizer											
Corn (grain)	150	X	0.9	=	135	-	0	-	0	135	52,000
Example: Corn with Nitrogen Contribution from Previous Crop (e.g., Soybeans) and No Chemical Fertilizer											
Corn (grain)	150	X	0.9	=	135	-	30	-	0	105	40,000
Example: Corn with Nitrogen Contribution from Chemical Fertilizer and No Contribution from Previous Crop											
Corn(grain)	150	X	0.9	=	135	-	0	-	20	115	44,000
Example: Soybeans with Nitrogen Contribution from Previous Crop (e.g., alfalfa) and No Chemical Fertilizer											
Soybeans	60	X	3.8	=	228	-	40	-	0	188	72,000

Your Calculations

Crop: Choose crop to be planted and harvested at the land site.

*** Expected Crop Yield: Certified 3-5 year crop yields previously obtained at the land site.**

****Nitrogen Removal: Use current issue of Nutrient Recommendations for Field Crops in Michigan (Extension Bulletin E2904).**

*****Nitrogen Requirement (Lb N Removed/ac): Expected Crop Yield multiplied by Nitrogen Removal.**

******Nitrogen from Previous Crop (N Credit): Use current issue of Nutrient Recommendations for Field Crops in Michigan (Extension Bulletin E2904). Deduct N credit from nitrogen requirement if previous crop is a legume or legume-small grain mixture.**

*******Nitrogen from chemical (starter or regular) fertilizer: Deduct N credit from nitrogen requirement if N fertilizer is applied during cropping year.**

Total Nitrogen Requirement: Actual N requirement for crop Yield.

AAR = Agronomic Application Rate: Maximum rate of septage application in gallons per acre per year. The maximum agronomic application rate shall not exceed 100,000 gallons per acre per year.

Sources for Crop Yields: 1) National Agricultural Statistics Service, USDA.
Website address: www.nass.usda.gov
2) MSU Extension Offices (Ask about Certified Yields)
3) Farmers (Certified or documented records)
4) County Soil Survey, USDA, Natural Resources Conservation Service, and Forest Service

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Winter Disposal Plan:
(Check all that apply)

- ☐ **Wastewater Treatment Plant**
- ☐ **Land Application only, with a written plan**
- ☐ **No Septage Pumping During Winter**
- ☐ **Storage Facility**

Reminders: Effective October 12, 2006, a person shall not surface apply septage to frozen ground.

Effective October 12, 2006, before land application, domestic septage shall be screened through a screen of not greater than ½-inch mesh or through slats separated by a gap of not greater than 3/8-inch.

Appendix H

SEPTAGE LIME STABILIZATION LOG

Land Applier: _____

Date	**Time**	After Lime Addition **Initial pH**	*Initial* **Temp** **Degrees Celsius**	*Initial* **Adjusted pH***	**30 Minute pH** **Time** / **pH**	*30 Minute* **Temp**	*30 Minute* **Adjusted pH***	**Volume (gallons)**	**Farm**	**Field**	**Weather**
Explanation of discrepancies:											

Lime Stabilization Log

Appendix I

ALKALI STABILIZATION LOG & pH CONVERSION CHART

pH Correction Chart			
Temperature (Celsius)	pH Correction	Temperature (Celsius)	pH Correction
0	-0.75	25	0.00
1	-0.72	26	0.03
2	-0.69	27	0.06
3	-0.66	28	0.09
4	-0.63	29	0.12
5	-0.60	30	0.15
6	-0.57	31	0.18
7	-0.54	32	0.21
8	-0.51	33	0.24
9	-0.48	34	0.27
10	-0.45	35	0.30
11	-0.42	36	0.33
12	-0.39	37	0.36
13	-0.36	38	0.39
14	-0.33	39	0.42
15	-0.30	40	0.45
16	-0.27	41	0.48
17	-0.24	42	0.51
18	-0.21	43	0.54
19	-0.18	44	0.57
20	-0.15	45	0.60
21	-0.12	46	0.63
22	-0.09	47	0.66
23	-0.06	48	0.69
24	-0.03	49	0.72
25	0.00	50	0.75

pH Meter Calibration Log

Date / Time	Slope	Date / Time	Slope

Appendix J

LAND APPLICATION VOLUME RECORD

Business Name: _____ County of Land Site: _____ Section: _____ Year: _____

Site Address: _____ Site I.D #: _____ City: _____ Twp: _____

Date of Septage Application	Field Number	Number Of Acres	Number of Gallons	Method of Application		Time of Application	Time of Incorporation	Lime Stabilization	Comment
				Surface	Injection				
7/15/05	1A	5	1,500	Yes	No	10:00 a.m.	4:00 p. m	No	6-hr incorp.
8/9/05	3B	10	2,000	No	Yes	2:00 p.m.	NA	Yes	
		Total =							

Note: Complete this form for one land site with one or more fields. NA = Not Applicable

APPENDIX K

SUMMARY OF APPLICATION MATERIALS AND PROCESS FOR A NEW LAND SITE

The following information shall be provided and process followed when applying for a new land disposal site or when your license expires and is renewed every 5 years:

1. **Fill Applicable Sections of Land Site Application Form Completely "Application for Site Permit to Land Apply Septage Waste" – EQP 5837.**

2. **Attach Land Site Identification Documents:**

   a. County land atlas and plat book.

   b. Latitude and Longitude

   c. Name and Address of Land Owner

   d. Name and Address of Land Manager

   e. Soil Fertility Test Report

   f. Site Plan

   g. Other Maps
   - Vicinity Map
   - Aerial Map
   - Topographic Map
   - Soil Map

3. **Payment of applicable fee**

4. **Send Application Packet to:** Department of Environmental Quality
   Cashier's Office-WB-SEP1
   P. O. Box 30657
   Lansing. MI 48909-8157

5. **Simultaneous to No. 4 above, send <u>Notice of Application</u> that includes 2 (a-d) above to:**
   a. **Local health department having jurisdiction**
   b. **Clerk of city, village, or township where site is located**
   c. **Each person who owns a lot or parcel that is contiguous or would be contiguous except for the presence of a highway, road, or street to the proposed land site.**
   d. **Each person who owns a lot or parcel within 150 ft or 800 ft to the proposed land site.**

<u>Other Information</u>: Other site specific information may be requested by MDEQ.

For details see Michigan Septage Law, Part 117 Septage Waste Servicers and Chapter 4 of the guidance manual.

REFERENCES

1. Brady, Nyle C. and Weil, Ray R. 2002. The Nature and Properties of Soils. 13th Ed. Prentice Hall, Upper Saddle River, New Jersey 07458.

2. Michigan Biosolids Law. 1999. Part 24, Land Application of Biosolids. Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended, R 323.2410(8).

3. Michigan Department of Environmental Quality. Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the Administrative Rules.

4. Michigan Septage Law. Part 117, Septage Waste Servicers, NREPA, Act 451 of PA 1994, as amended. Enacted 2004.

5. Ministry of the Environment. 2004. Septage, Alkaline Stabilization Process Arrangement. Ontario, Canada

6. Missouri Agricultural Experiment Station SB 1001. 1998. Recommended Chemical Soil Test Procedures for the North Central Region. North Central Regional Research Publication No. 221.

7. Nugent, Mike, Michael A. Kamrin, Lois Wolfson and Frank M. D'Itri. 1993. Nitrate – A Drinking Water Concern. Michigan State University Extension Bulletin WQ-19

8. Recommended Chemical Soil Test Procedures for the North Central Region. 1998. North Central Regional Research Publication No. 221 (Revised). Missouri Agricultural Experiment Station SB 1001.

9. Sampling Soils for Fertilizer and Lime Recommendations. 1998. Michigan State University Extension Bulletin E- 0498

10. United States Department of Agriculture and Natural Resources Conservation Service. Soil Survey. Contact Address: State Conservationist 3001 Coolidge Road, Suite 250, East Lansing, MI 48823-6350. Phone (517) 324-5270, Fax (517) 324-5271.

11. United States Department of Agriculture, National Agricultural Statistics Service. Crop Yield Data in Michigan. www.nass.usda.gov

12. U.S. Environmental Protection Agency. 1981. Process Design Manual. Land Treatment of Municipal Wastewater. EPA-625-1-81-013.

13. U.S. Environmental Protection Agency. 1993. Domestic Septage Regulatory Guidance. A Guide to the EPA 503 Rule. EPA-832-B-92-005.

14. U.S. Environmental Protection Agency. 1993. Hauled Domestic Waste Land Application of Septage. A Region 5 Introspective. Chicago, Illinois.

15. U.S. Environmental Protection Agency. 1994. Guide to Septage Treatment and Disposal. EPA-625-R-94-002

16. U.S. Environmental Protection Agency. 1994. Land application of sewage sludge. A guide for land appliers on the requirements of the Federal standards for the use or disposal of sewage sludge, 40 CFR Part 503 EPA-831-B-93-002b

17. U.S. Environmental Protection Agency. Federal Septage Law, CFR 40, Part 257.3 – 5. Criteria for Classification of Solid Waste Disposal Facilities and Practices.

18. U.S. Environmental Protection Agency. Federal Septage Law, CFR 40. Part 503 Standards for the Use or Disposal of Sewage Sludge. Effective 1993.

19. Warncke, D, J.G. Dahl and M.L. Vitosh. 19. Understanding the MSU Soil test Report: Results and Recommendations**.** Michigan State University Extension Bulletin E-2058.

20. Warncke, D, J. Dahl, L. Jacobs and C. Laboski. 2004. Nutrient Recommendations for Field Crops in Michigan. Michigan State University Extension Bulletin E-2904.

21. Michigan Department of Agriculture. 2005. Generally Accepted Agricultural and Management Practices for Nutrient Utilization. Michigan Right-to-Farm Act, 1981, PA 93.